FIG.1

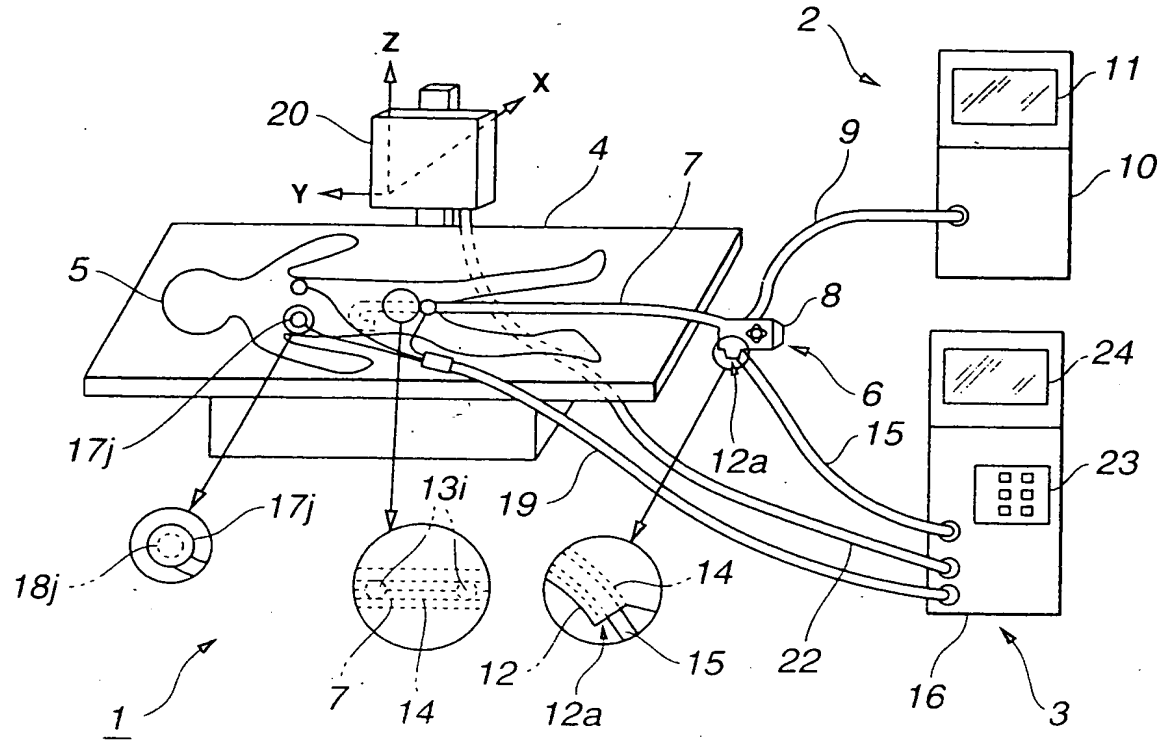

Z
X
Y
20
4
7
9
2
11
10
5
8
24
6
17j
15
12a
23
13i
19
17j
18j
14
12
15
22
16
3
7
14
12a
1

FIG.2

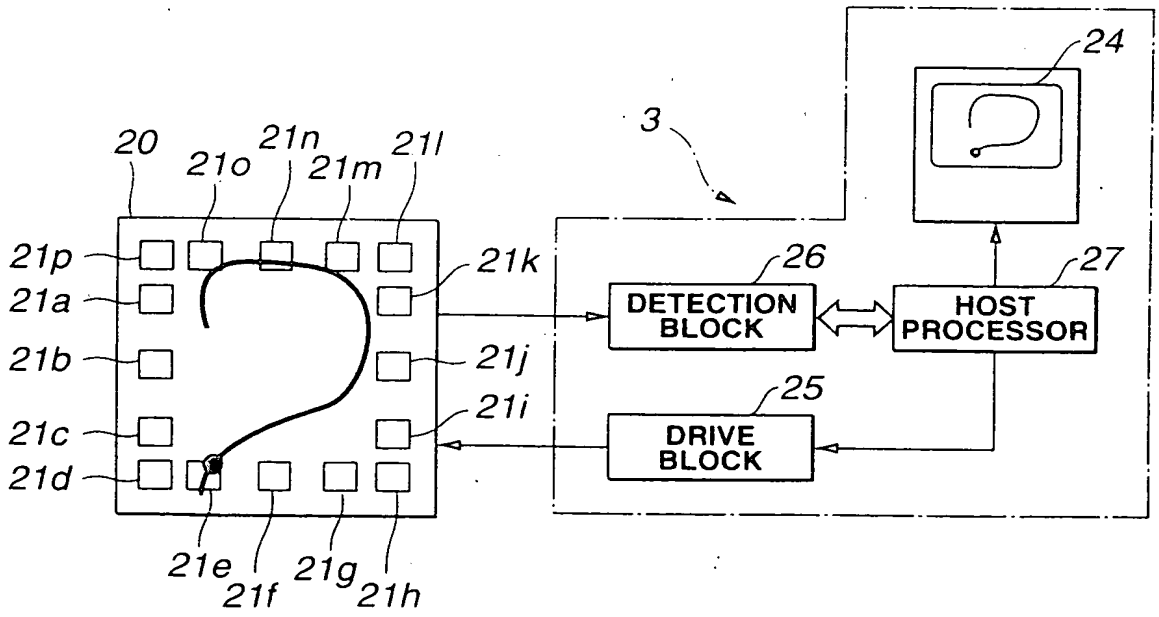

24
3
20
21o
21n
21m
21l
21p
21a
21b
21c
21d
21k
21j
21i
26
27
DETECTION BLOCK
HOST PROCESSOR
25
DRIVE BLOCK
21e
21f
21g
21h

FIG.3

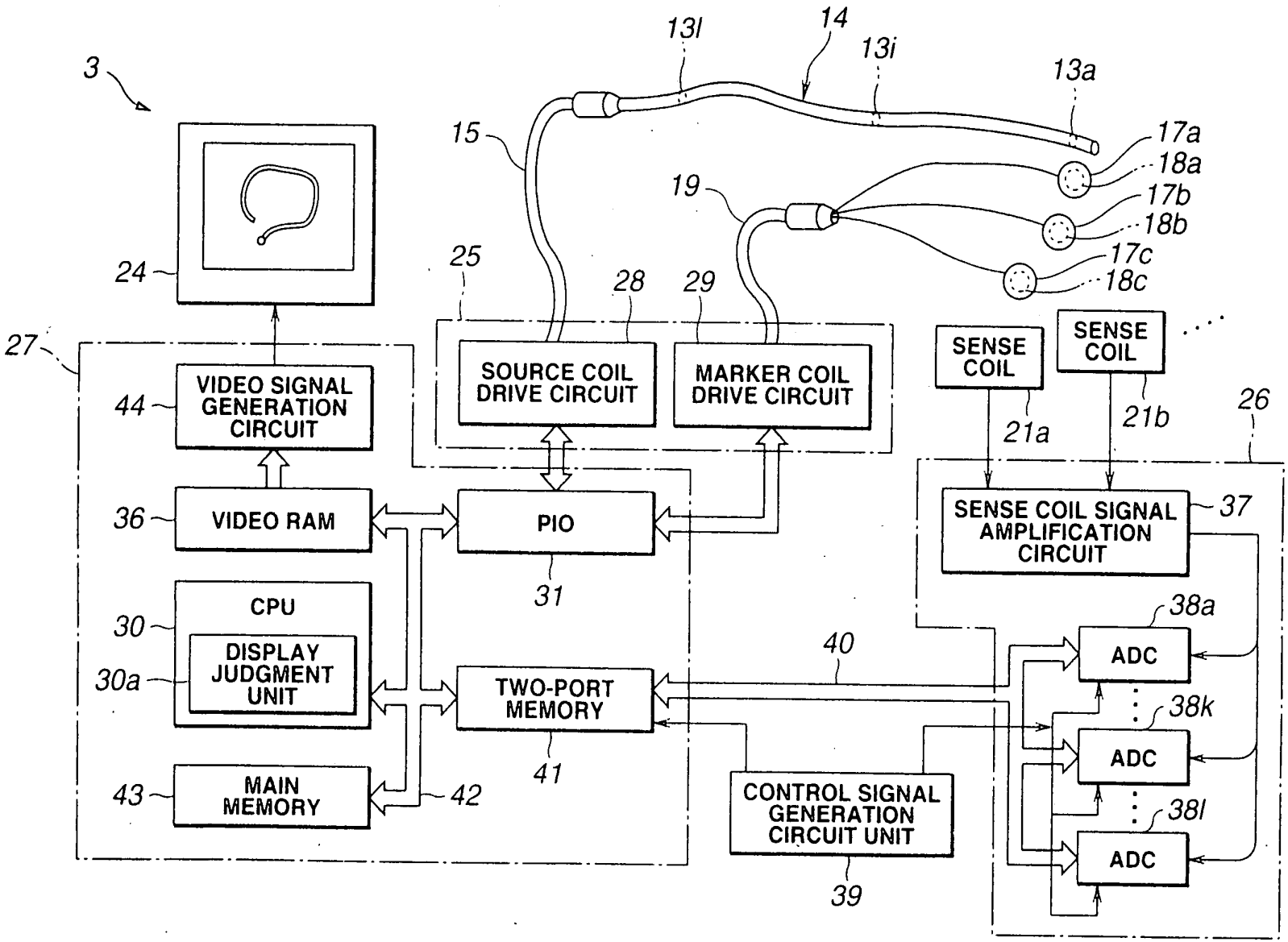

3
13l
14
13i
13a
15
17a
18a
19
17b
18b
17c
18c
24
25
28
29
27
SOURCE COIL DRIVE CIRCUIT
MARKER COIL DRIVE CIRCUIT
SENSE COIL
SENSE COIL
44
VIDEO SIGNAL GENERATION CIRCUIT
21a
21b
26
36
VIDEO RAM
PIO
SENSE COIL SIGNAL AMPLIFICATION CIRCUIT
37
31
CPU
30
38a
40
30a
DISPLAY JUDGMENT UNIT
TWO-PORT MEMORY
ADC
38k
ADC
41
43
MAIN MEMORY
42
CONTROL SIGNAL GENERATION CIRCUIT UNIT
38l
ADC
39

FIG.4A

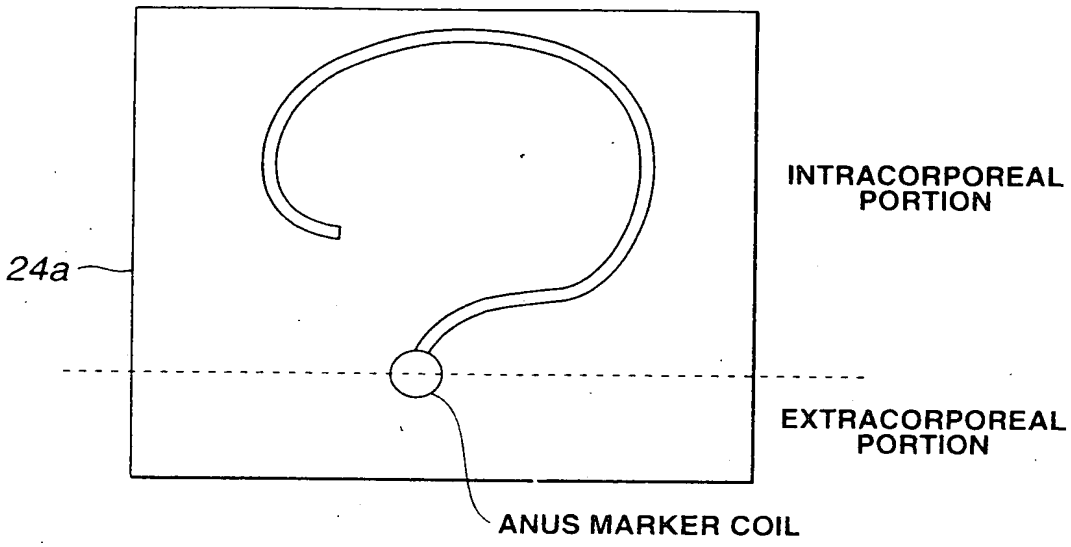


FIG.4B

EXAMPLE OF GRAPHICAL INDICATION ON MONITOR ACCORDING TO RELATED ART

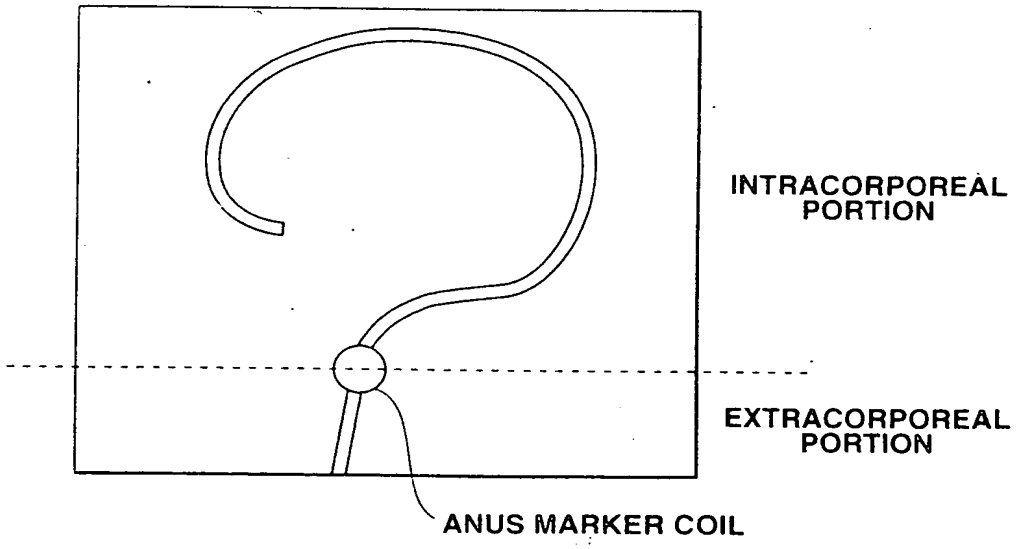


FIG.5

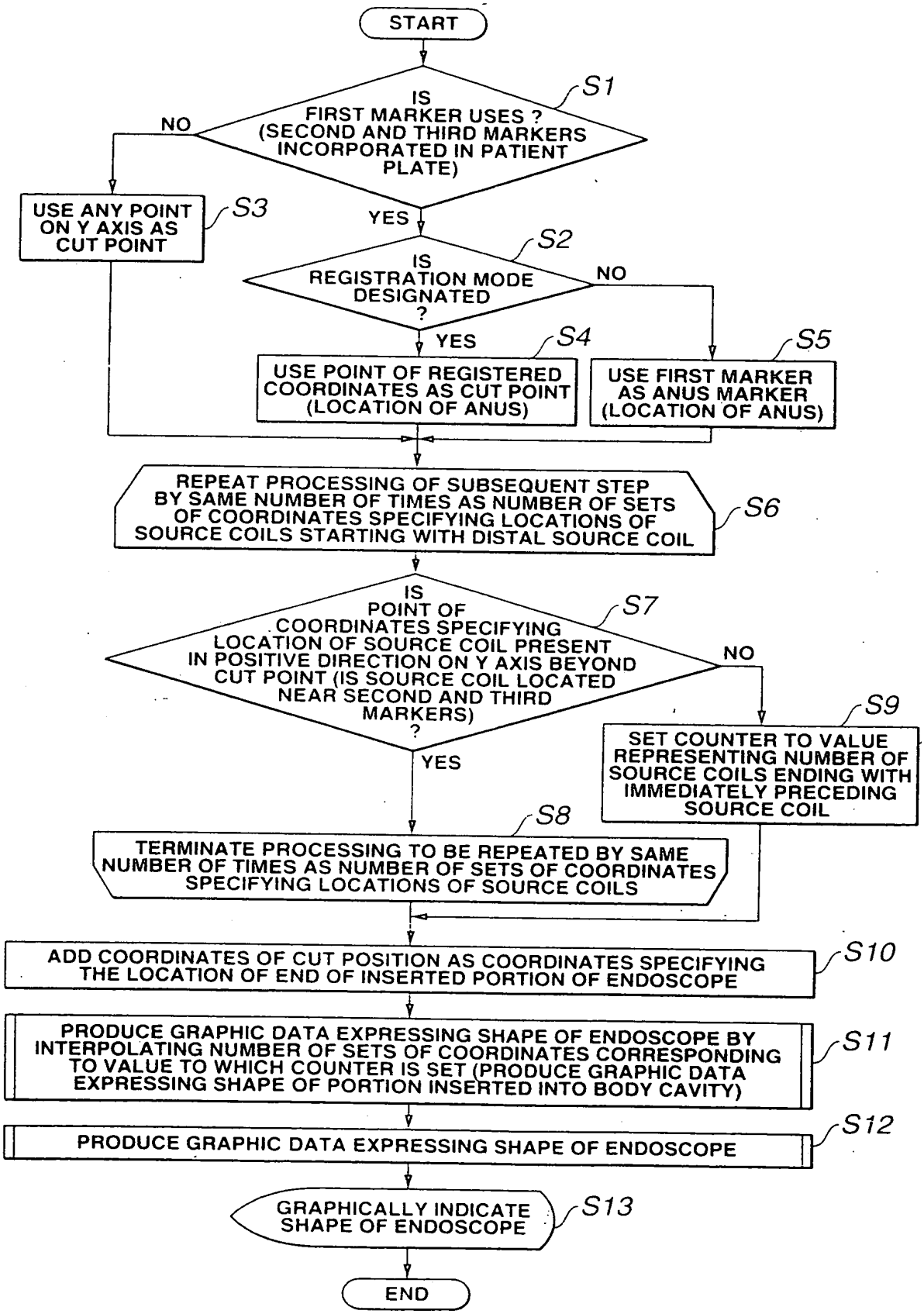

START
IS FIRST MARKER USES ? (SECOND AND THIRD MARKERS INCORPORATED IN PATIENT PLATE)
S1
NO
YES
USE ANY POINT ON Y AXIS AS CUT POINT
S3
IS REGISTRATION MODE DESIGNATED ?
S2
NO
YES
USE POINT OF REGISTERED COORDINATES AS CUT POINT (LOCATION OF ANUS)
S4
USE FIRST MARKER AS ANUS MARKER (LOCATION OF ANUS)
S5
REPEAT PROCESSING OF SUBSEQUENT STEP BY SAME NUMBER OF TIMES AS NUMBER OF SETS OF COORDINATES SPECIFYING LOCATIONS OF SOURCE COILS STARTING WITH DISTAL SOURCE COIL
S6
IS POINT OF COORDINATES SPECIFYING LOCATION OF SOURCE COIL PRESENT IN POSITIVE DIRECTION ON Y AXIS BEYOND CUT POINT (IS SOURCE COIL LOCATED NEAR SECOND AND THIRD MARKERS) ?
S7
NO
YES
SET COUNTER TO VALUE REPRESENTING NUMBER OF SOURCE COILS ENDING WITH IMMEDIATELY PRECEDING SOURCE COIL
S9
TERMINATE PROCESSING TO BE REPEATED BY SAME NUMBER OF TIMES AS NUMBER OF SETS OF COORDINATES SPECIFYING LOCATIONS OF SOURCE COILS
S8
ADD COORDINATES OF CUT POSITION AS COORDINATES SPECIFYING THE LOCATION OF END OF INSERTED PORTION OF ENDOSCOPE
S10
PRODUCE GRAPHIC DATA EXPRESSING SHAPE OF ENDOSCOPE BY INTERPOLATING NUMBER OF SETS OF COORDINATES CORRESPONDING TO VALUE TO WHICH COUNTER IS SET (PRODUCE GRAPHIC DATA EXPRESSING SHAPE OF PORTION INSERTED INTO BODY CAVITY)
S11
PRODUCE GRAPHIC DATA EXPRESSING SHAPE OF ENDOSCOPE
S12
GRAPHICALLY INDICATE SHAPE OF ENDOSCOPE
S13
END

FIG.6A

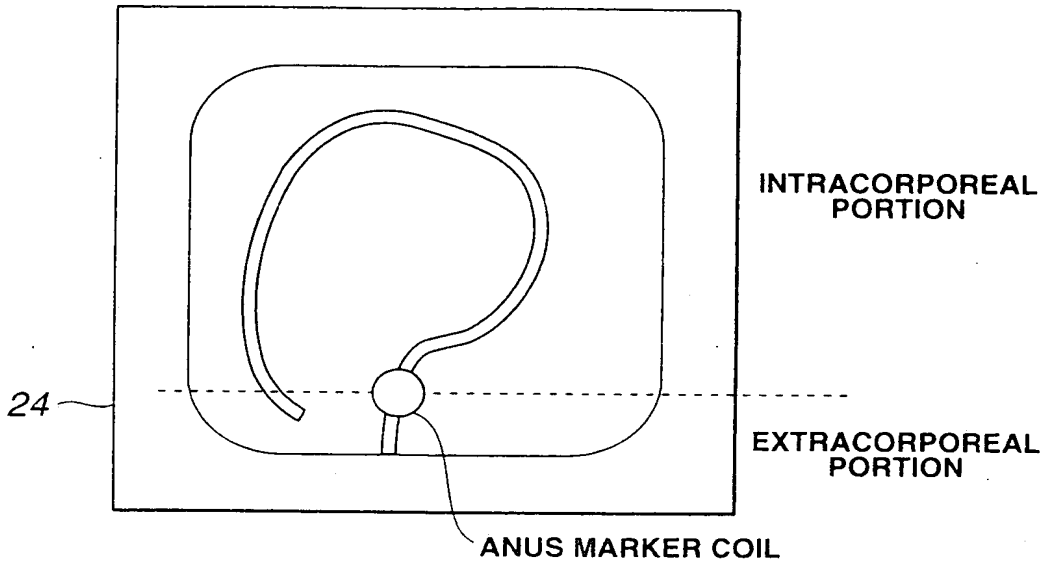

INTRACORPOREAL PORTION
24
EXTRACORPOREAL PORTION
ANUS MARKER COIL

FIG.6B

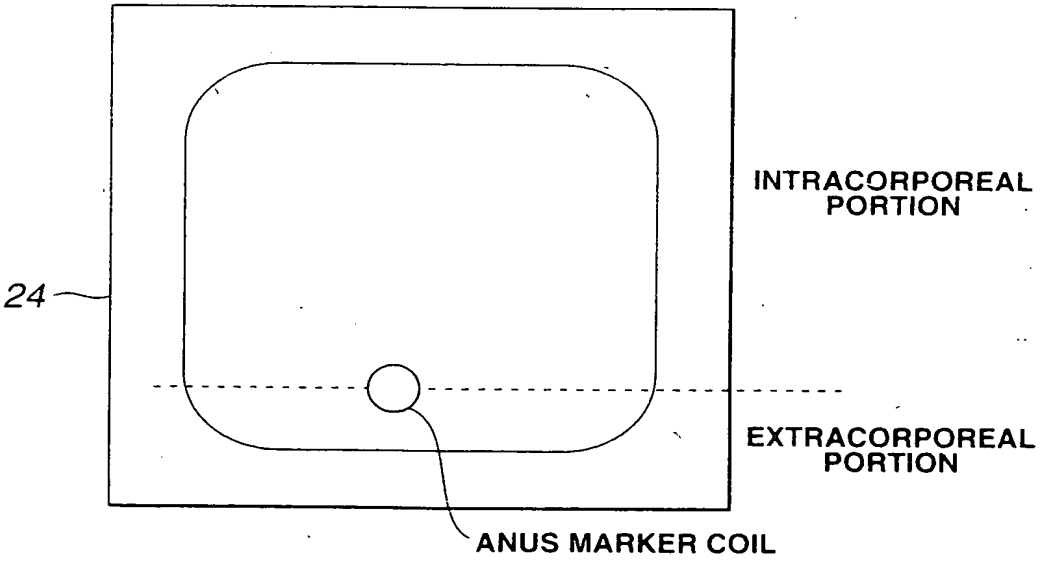

INTRACORPOREAL PORTION
24
EXTRACORPOREAL PORTION
ANUS MARKER COIL

FIG.7

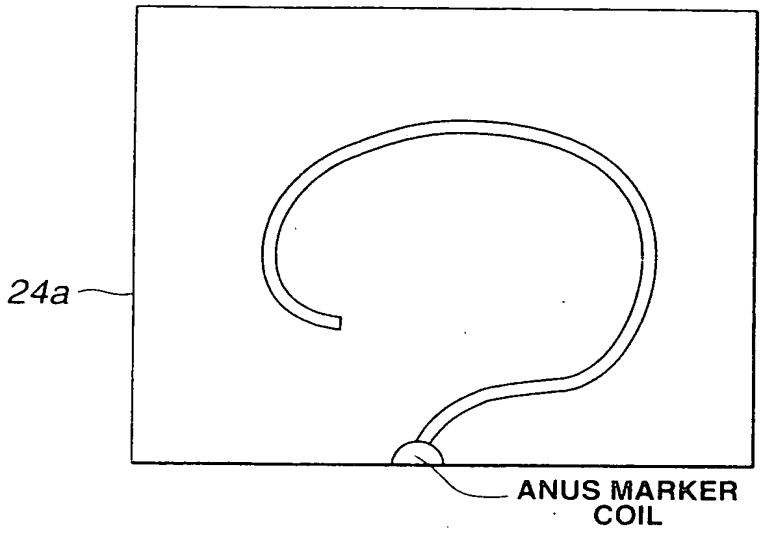


FIG.8A

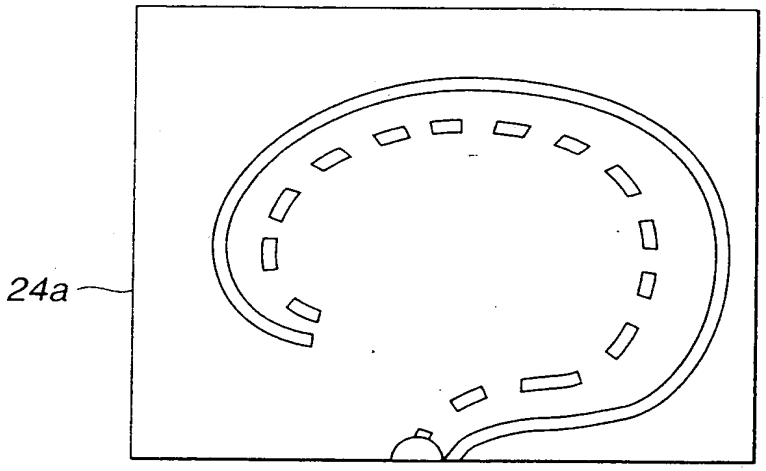


FIG.8B

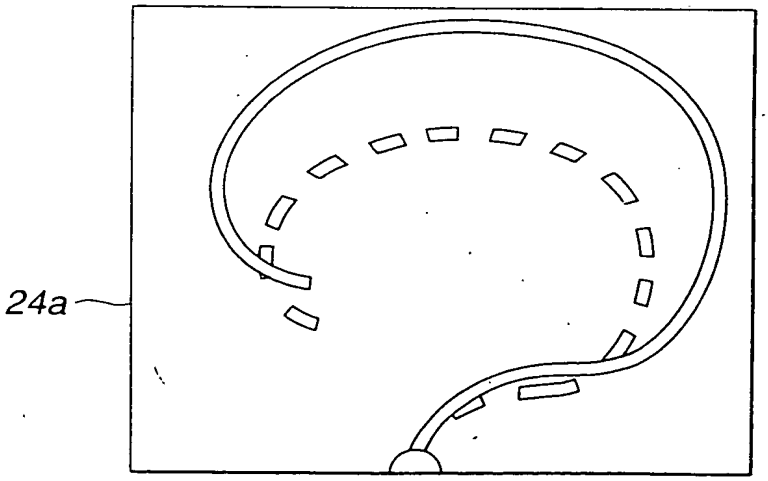


FIG.9A

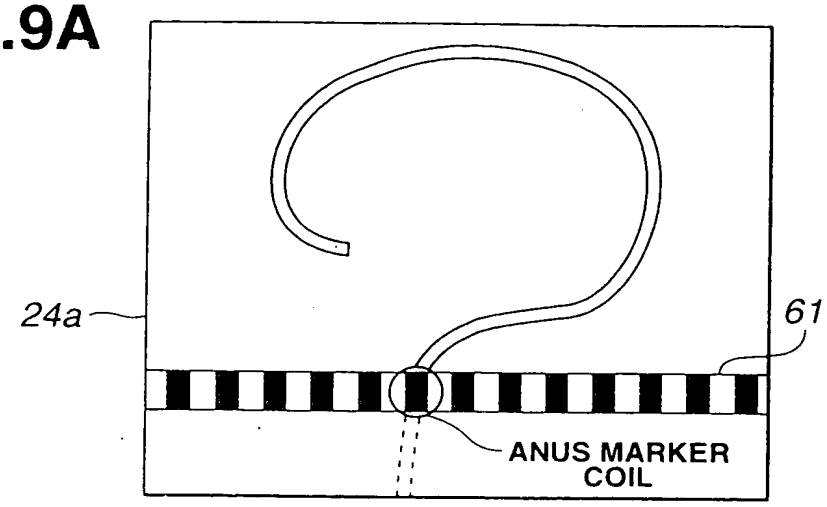


FIG.9B

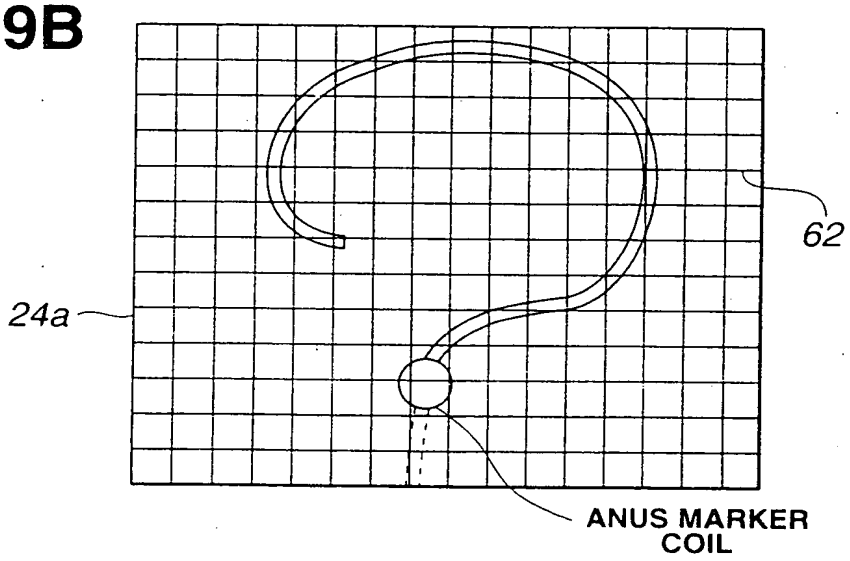


FIG.10

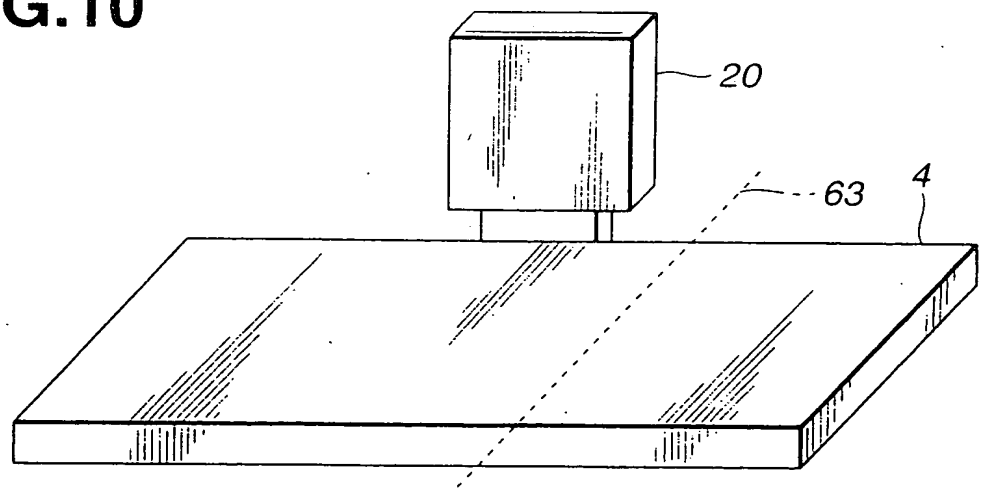


FIG.11A

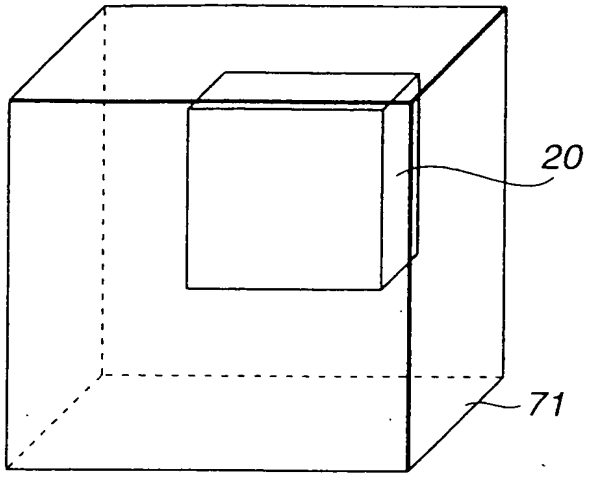


FIG.11B

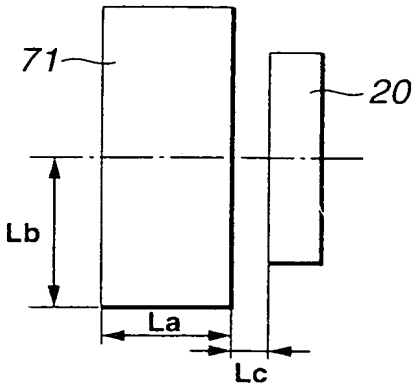


FIG.12A

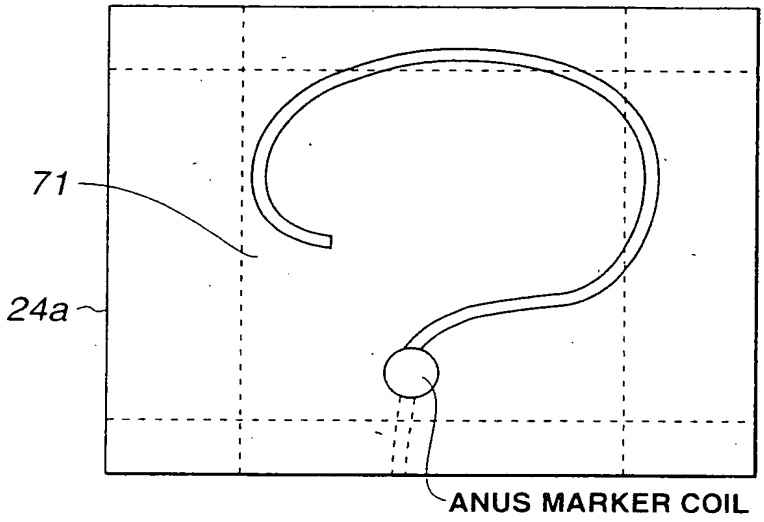


FIG.12B

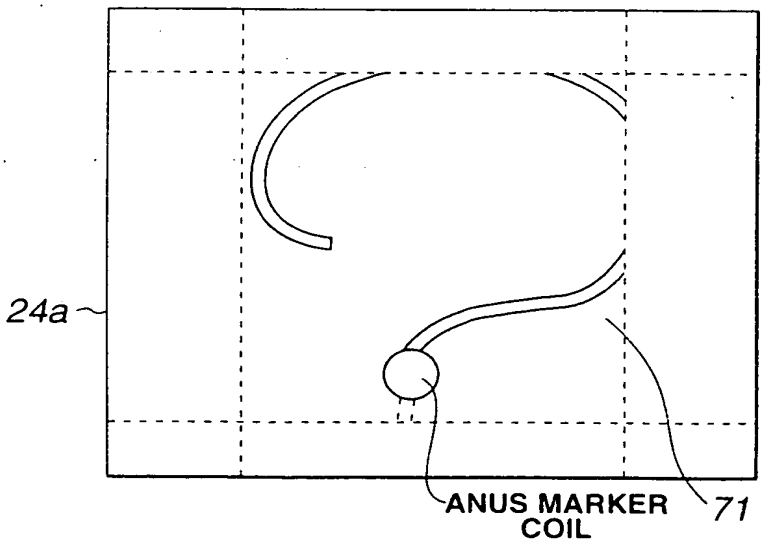


FIG.13A

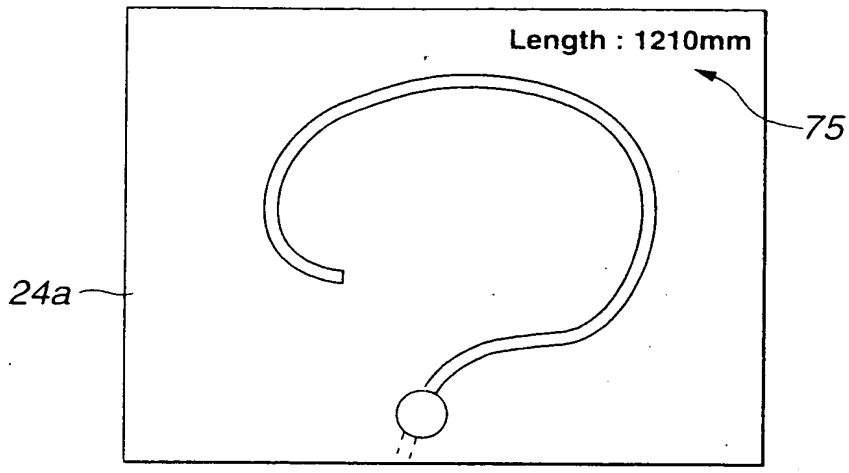


FIG.13B

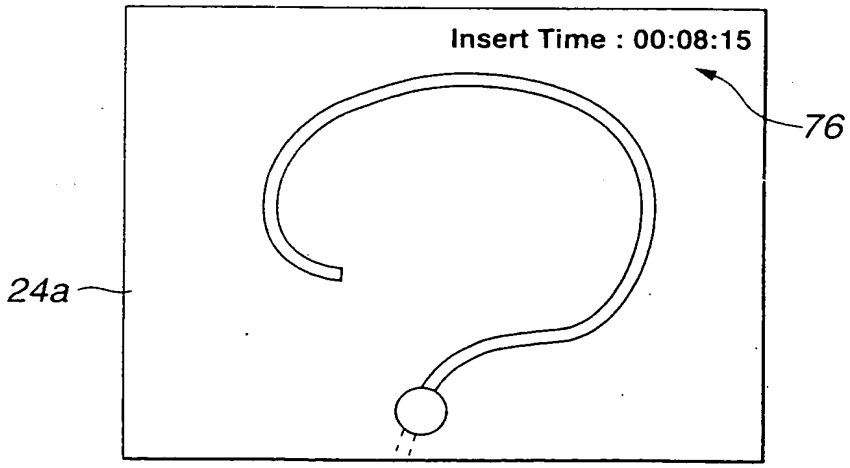


FIG.14

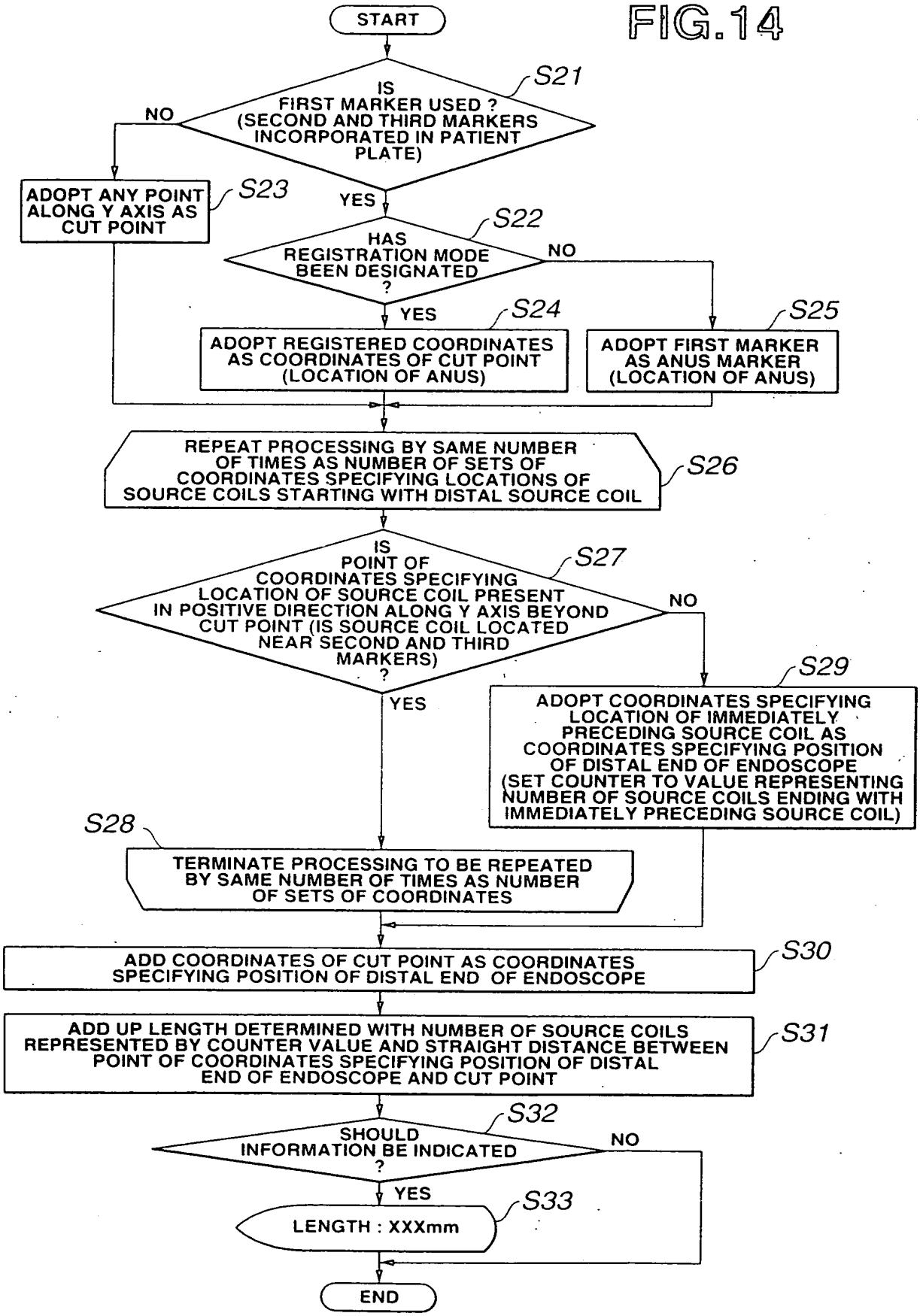

START
S21
IS FIRST MARKER USED ? (SECOND AND THIRD MARKERS INCORPORATED IN PATIENT PLATE)
NO
YES
S23
ADOPT ANY POINT ALONG Y AXIS AS CUT POINT
S22
HAS REGISTRATION MODE BEEN DESIGNATED ?
NO
YES
S24
ADOPT REGISTERED COORDINATES AS COORDINATES OF CUT POINT (LOCATION OF ANUS)
S25
ADOPT FIRST MARKER AS ANUS MARKER (LOCATION OF ANUS)
S26
REPEAT PROCESSING BY SAME NUMBER OF TIMES AS NUMBER OF SETS OF COORDINATES SPECIFYING LOCATIONS OF SOURCE COILS STARTING WITH DISTAL SOURCE COIL
S27
IS POINT OF COORDINATES SPECIFYING LOCATION OF SOURCE COIL PRESENT IN POSITIVE DIRECTION ALONG Y AXIS BEYOND CUT POINT (IS SOURCE COIL LOCATED NEAR SECOND AND THIRD MARKERS) ?
NO
YES
S29
ADOPT COORDINATES SPECIFYING LOCATION OF IMMEDIATELY PRECEDING SOURCE COIL AS COORDINATES SPECIFYING POSITION OF DISTAL END OF ENDOSCOPE (SET COUNTER TO VALUE REPRESENTING NUMBER OF SOURCE COILS ENDING WITH IMMEDIATELY PRECEDING SOURCE COIL)
S28
TERMINATE PROCESSING TO BE REPEATED BY SAME NUMBER OF TIMES AS NUMBER OF SETS OF COORDINATES
S30
ADD COORDINATES OF CUT POINT AS COORDINATES SPECIFYING POSITION OF DISTAL END OF ENDOSCOPE
S31
ADD UP LENGTH DETERMINED WITH NUMBER OF SOURCE COILS REPRESENTED BY COUNTER VALUE AND STRAIGHT DISTANCE BETWEEN POINT OF COORDINATES SPECIFYING POSITION OF DISTAL END OF ENDOSCOPE AND CUT POINT
S32
SHOULD INFORMATION BE INDICATED ?
NO
YES
S33
LENGTH : XXXmm
END

FIG.15

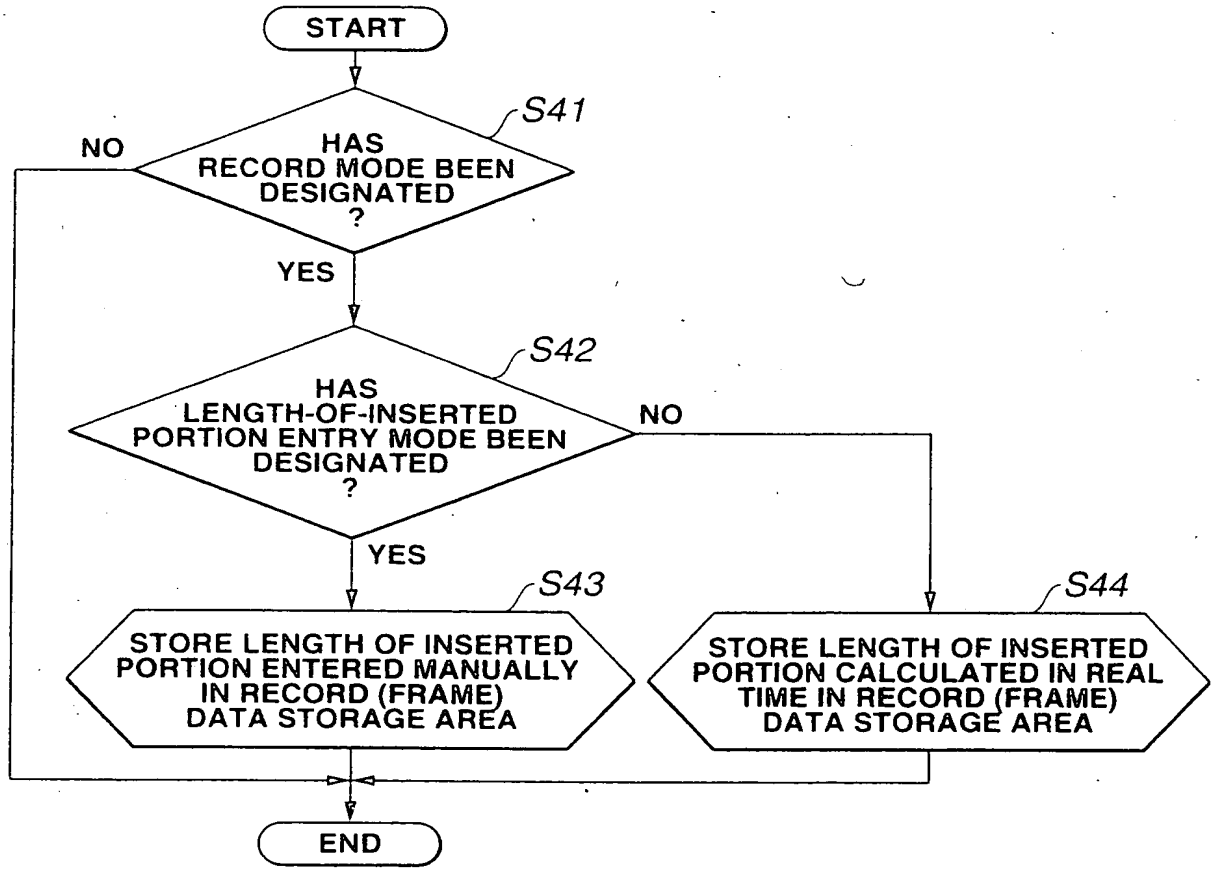

START
S41
HAS RECORD MODE BEEN DESIGNATED ?
NO
YES
S42
HAS LENGTH-OF-INSERTED PORTION ENTRY MODE BEEN DESIGNATED ?
NO
YES
S43
STORE LENGTH OF INSERTED PORTION ENTERED MANUALLY IN RECORD (FRAME) DATA STORAGE AREA
S44
STORE LENGTH OF INSERTED PORTION CALCULATED IN REAL TIME IN RECORD (FRAME) DATA STORAGE AREA
END

FIG.16

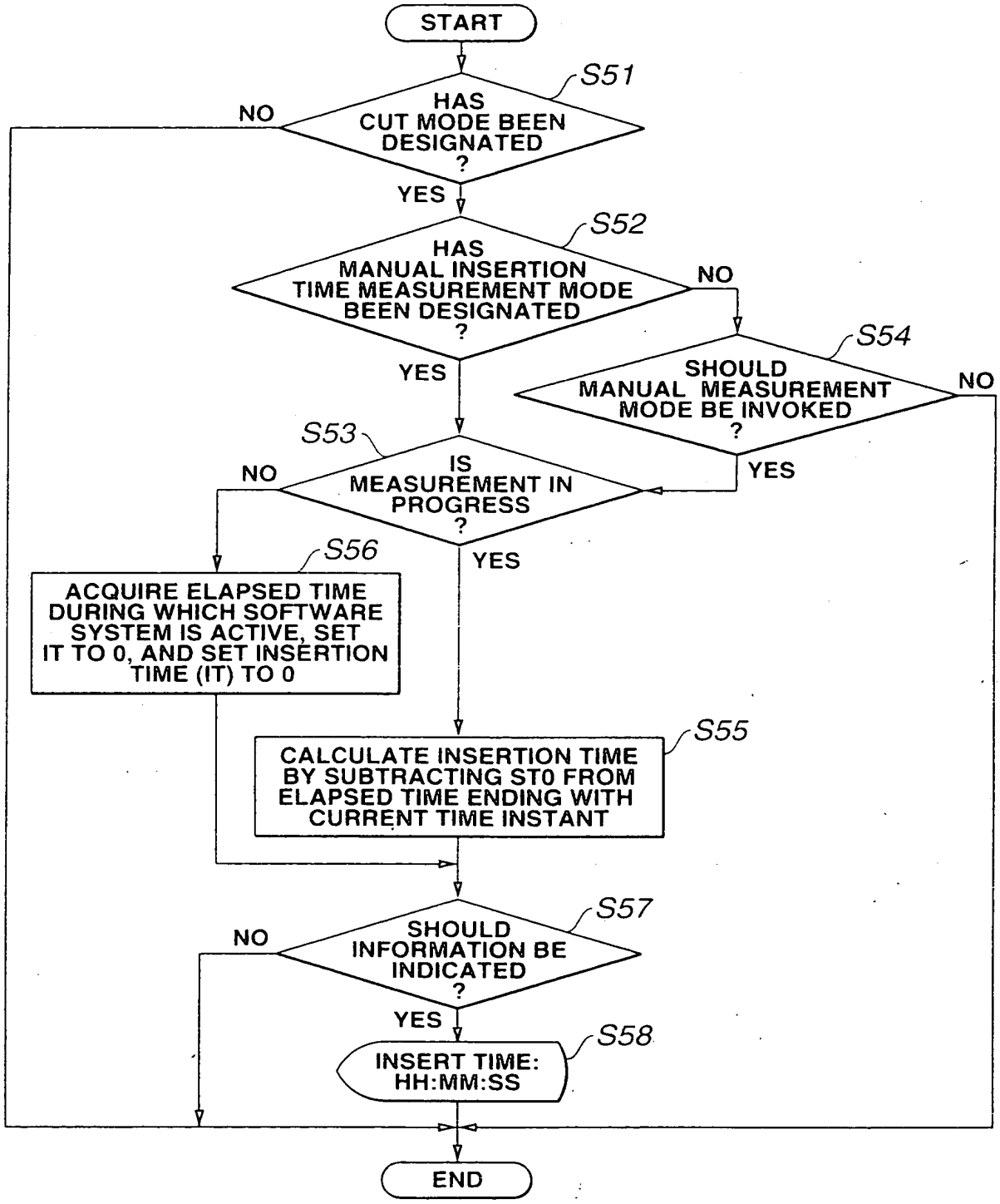

START
S51
HAS CUT MODE BEEN DESIGNATED ?
NO
YES
S52
HAS MANUAL INSERTION TIME MEASUREMENT MODE BEEN DESIGNATED ?
NO
YES
S54
SHOULD MANUAL MEASUREMENT MODE BE INVOKED ?
NO
YES
S53
IS MEASUREMENT IN PROGRESS ?
NO
YES
S56
ACQUIRE ELAPSED TIME DURING WHICH SOFTWARE SYSTEM IS ACTIVE, SET IT TO 0, AND SET INSERTION TIME (IT) TO 0
S55
CALCULATE INSERTION TIME BY SUBTRACTING ST0 FROM ELAPSED TIME ENDING WITH CURRENT TIME INSTANT
S57
SHOULD INFORMATION BE INDICATED ?
NO
YES
S58
INSERT TIME: HH:MM:SS
END

FIG.17A

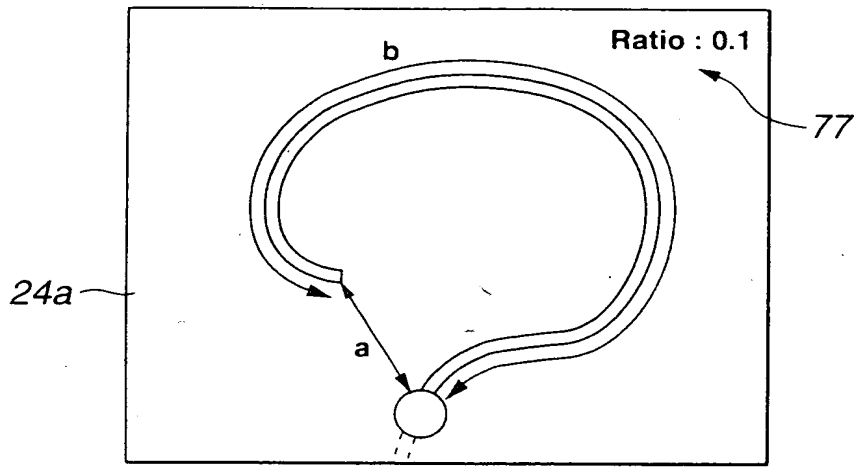


FIG.17B

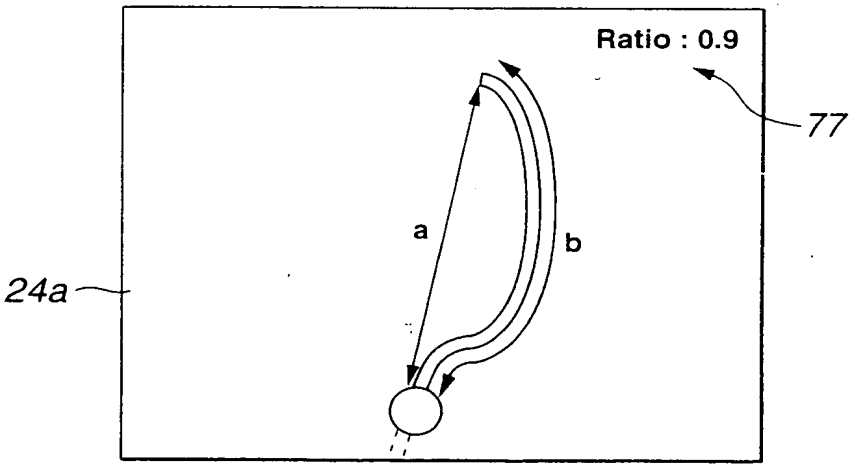


FIG.18

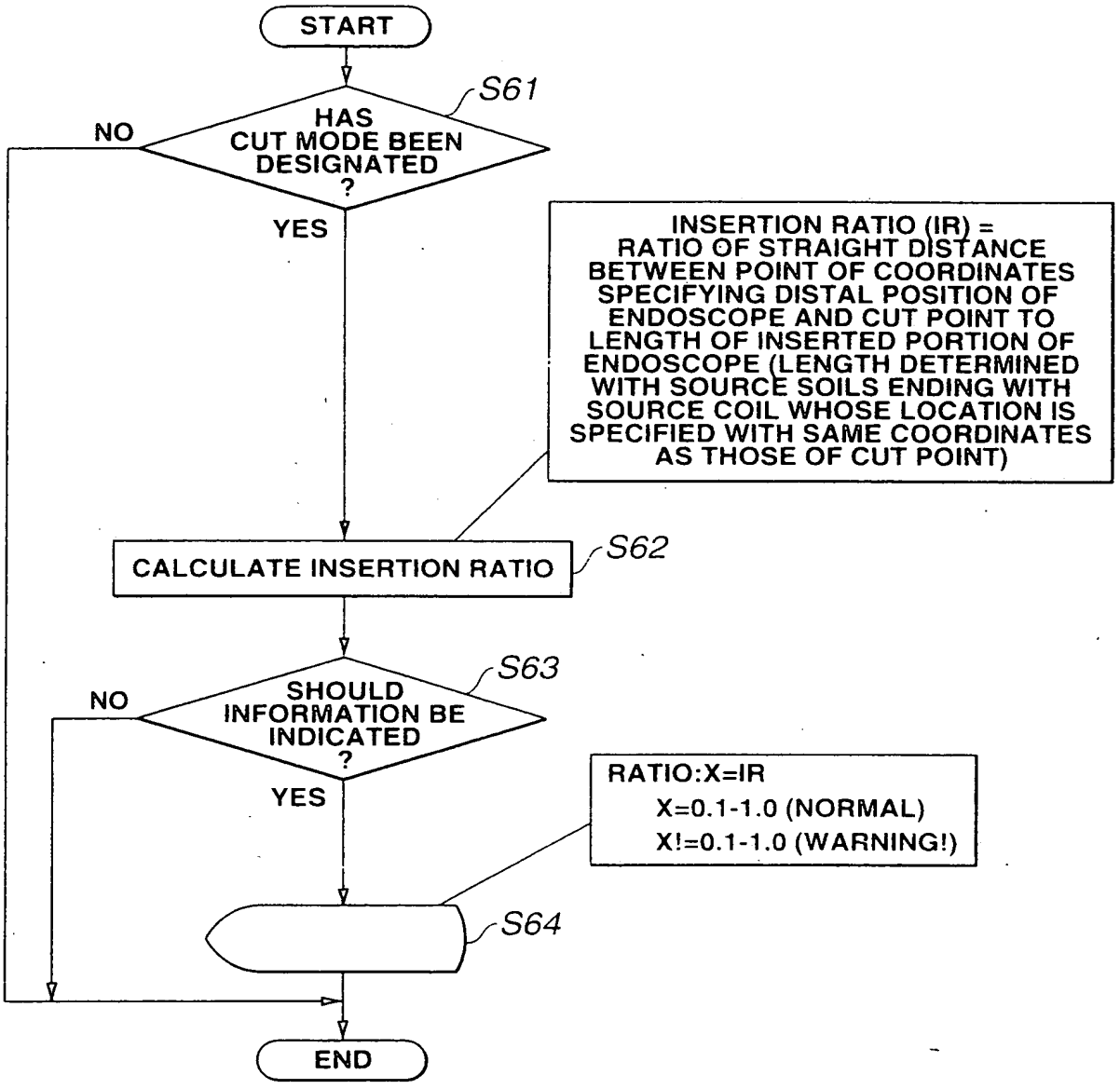

START
S61
HAS CUT MODE BEEN DESIGNATED ?
NO
YES
INSERTION RATIO (IR) = RATIO OF STRAIGHT DISTANCE BETWEEN POINT OF COORDINATES SPECIFYING DISTAL POSITION OF ENDOSCOPE AND CUT POINT TO LENGTH OF INSERTED PORTION OF ENDOSCOPE (LENGTH DETERMINED WITH SOURCE SOILS ENDING WITH SOURCE COIL WHOSE LOCATION IS SPECIFIED WITH SAME COORDINATES AS THOSE OF CUT POINT)
CALCULATE INSERTION RATIO
S62
S63
SHOULD INFORMATION BE INDICATED ?
NO
YES
RATIO:X=IR
X=0.1-1.0 (NORMAL)
X!=0.1-1.0 (WARNING!)
S64
END

FIG.19A

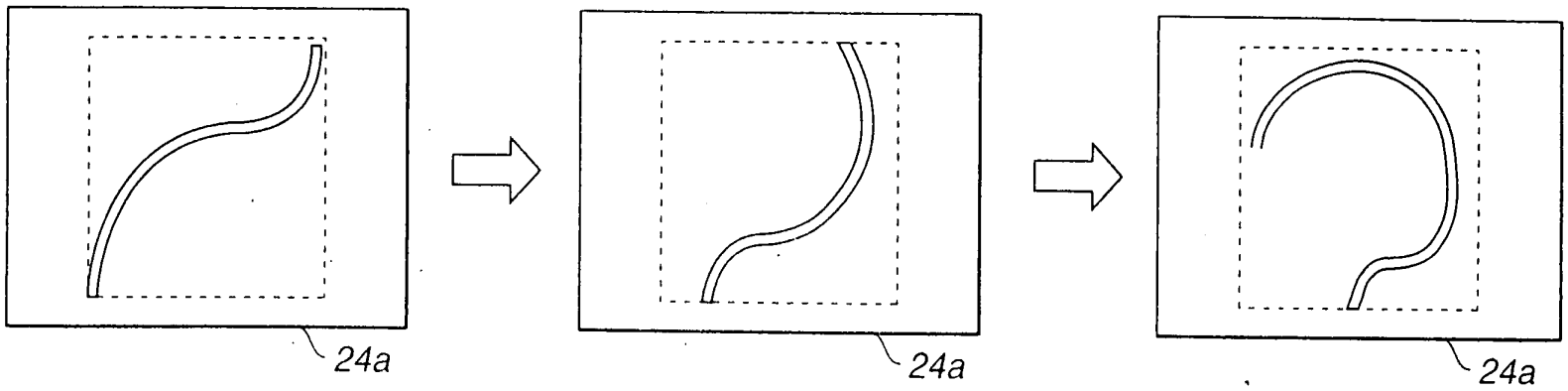


FIG.19B

EXAMPLE OF GRAPHICAL INDICATION IN ACCORDANCE WITH RELATED ART

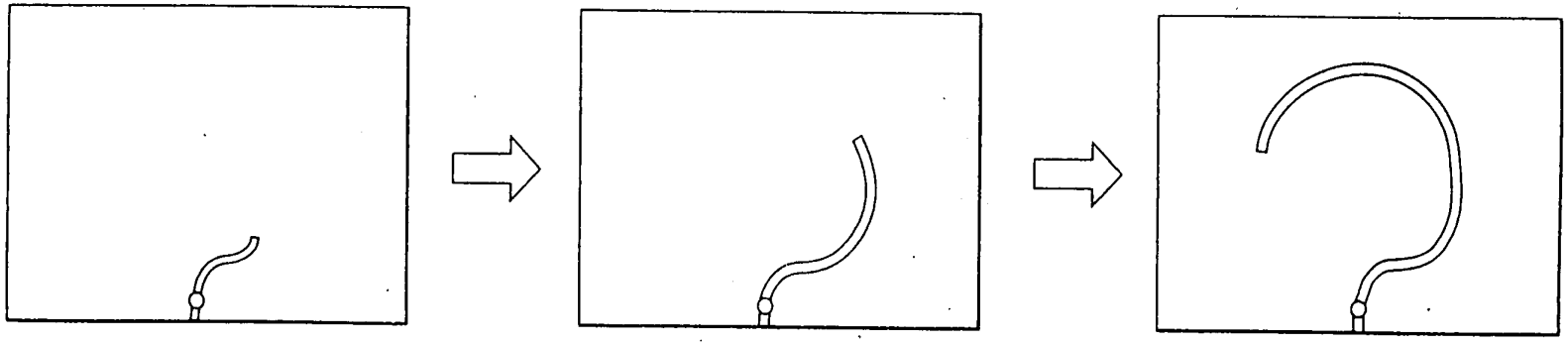


FIG.20A

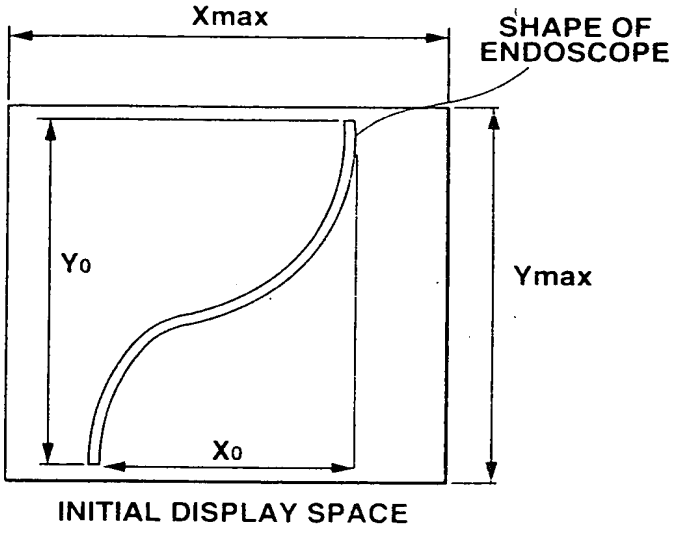


FIG.20B

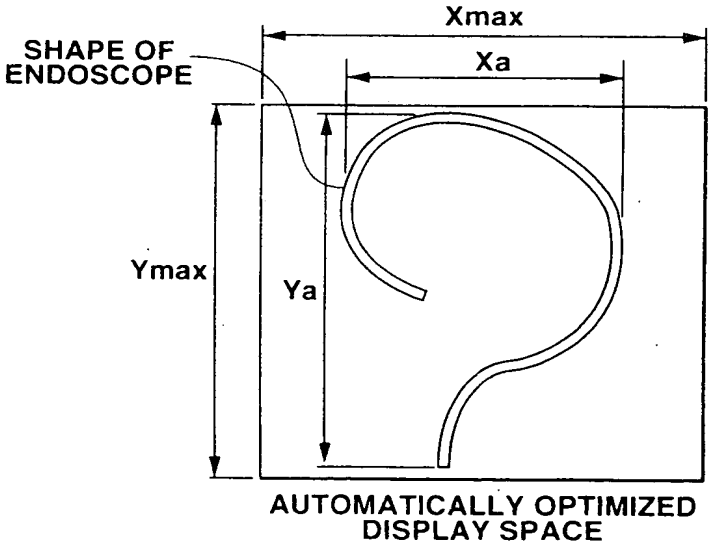


FIG.21

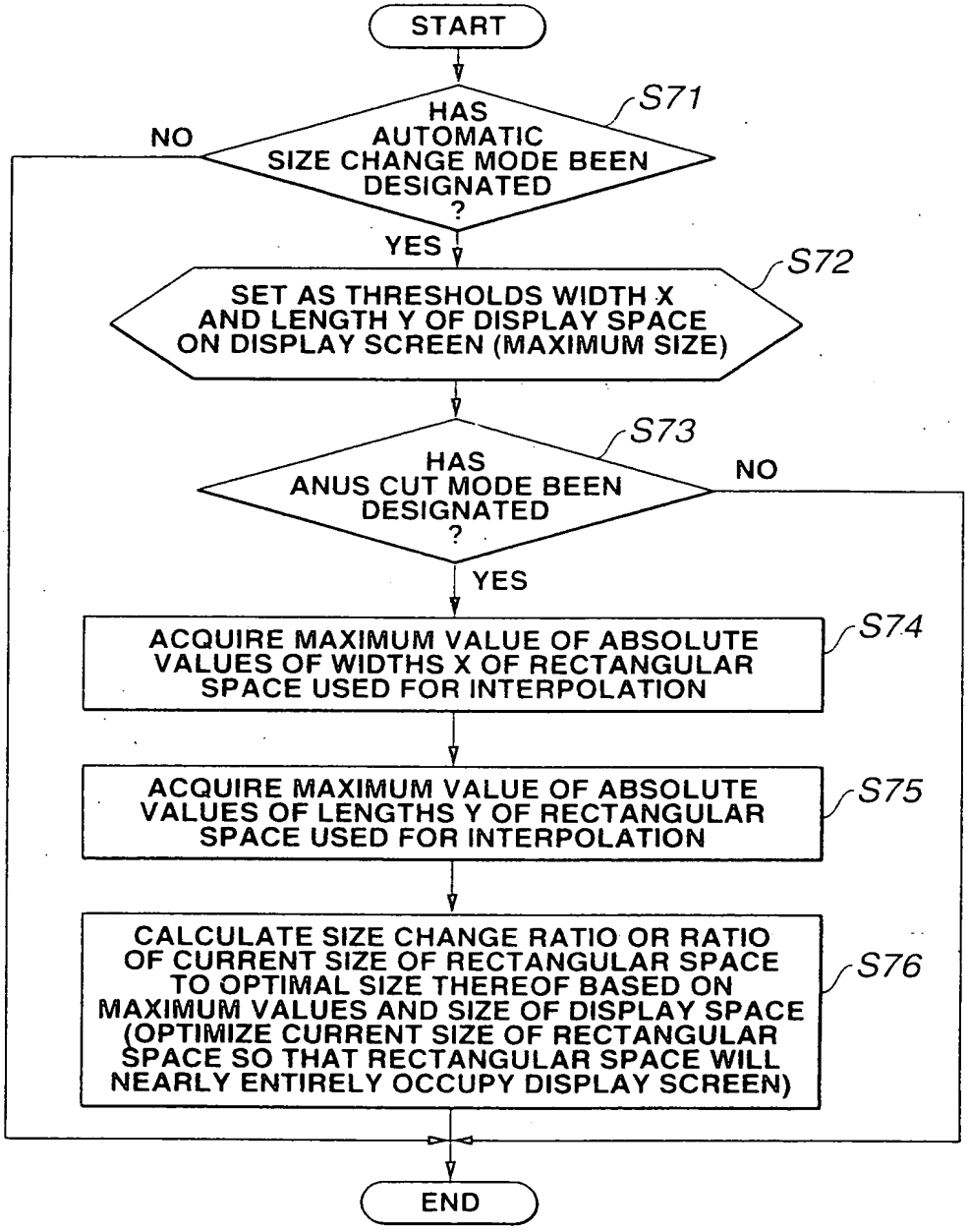

START
S71
HAS AUTOMATIC SIZE CHANGE MODE BEEN DESIGNATED ?
NO
YES
S72
SET AS THRESHOLDS WIDTH X AND LENGTH Y OF DISPLAY SPACE ON DISPLAY SCREEN (MAXIMUM SIZE)
S73
HAS ANUS CUT MODE BEEN DESIGNATED ?
NO
YES
S74
ACQUIRE MAXIMUM VALUE OF ABSOLUTE VALUES OF WIDTHS X OF RECTANGULAR SPACE USED FOR INTERPOLATION
S75
ACQUIRE MAXIMUM VALUE OF ABSOLUTE VALUES OF LENGTHS Y OF RECTANGULAR SPACE USED FOR INTERPOLATION
S76
CALCULATE SIZE CHANGE RATIO OR RATIO OF CURRENT SIZE OF RECTANGULAR SPACE TO OPTIMAL SIZE THEREOF BASED ON MAXIMUM VALUES AND SIZE OF DISPLAY SPACE (OPTIMIZE CURRENT SIZE OF RECTANGULAR SPACE SO THAT RECTANGULAR SPACE WILL NEARLY ENTIRELY OCCUPY DISPLAY SCREEN)
END

FIG.22

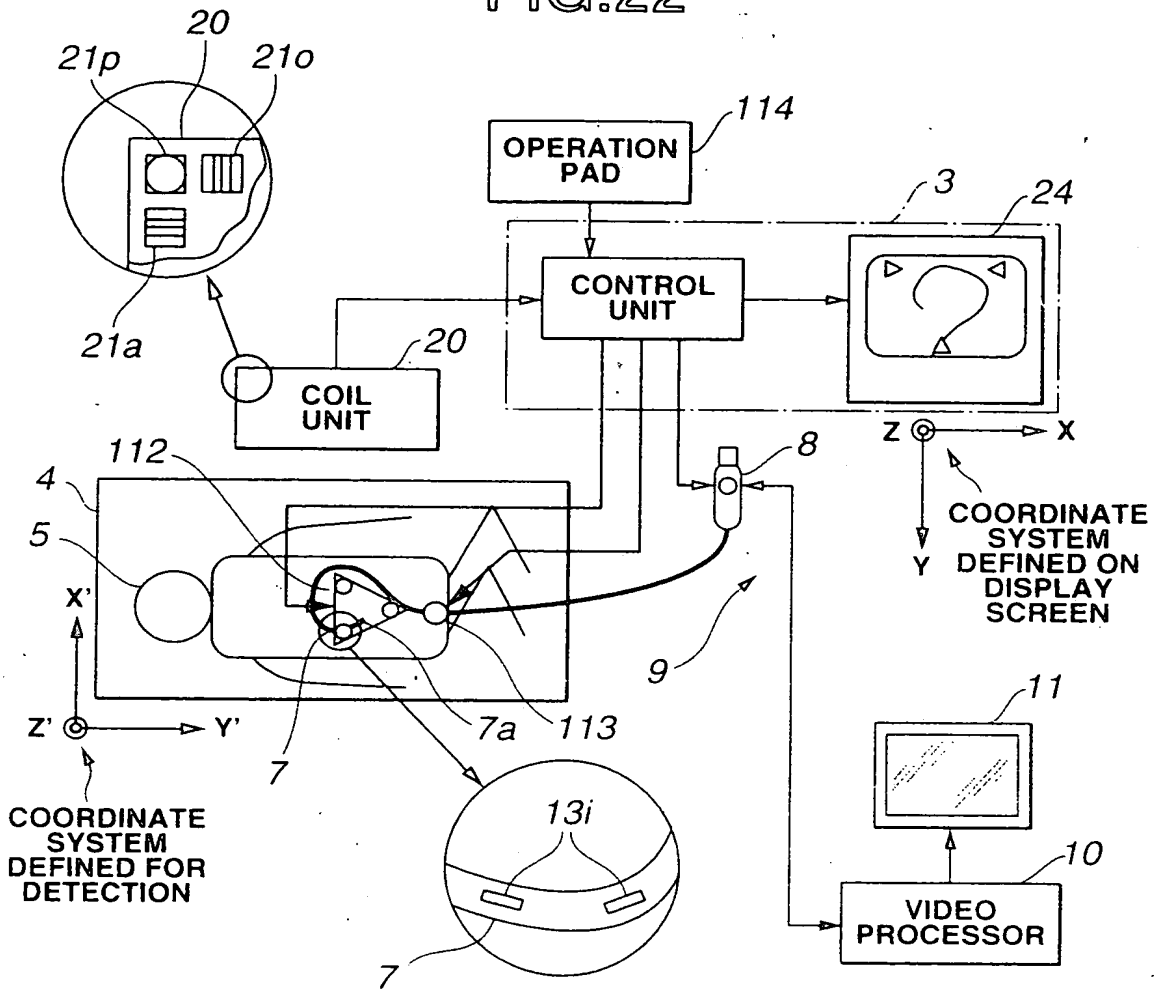

20
21p
21o
21a
OPERATION PAD
114
3
24
CONTROL UNIT
20
COIL UNIT
Z
X
Y
COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
112
4
5
8
X'
Z'
Y'
9
11
7a
113
7
13i
10
VIDEO PROCESSOR
COORDINATE SYSTEM DEFINED FOR DETECTION
7

FIG.23

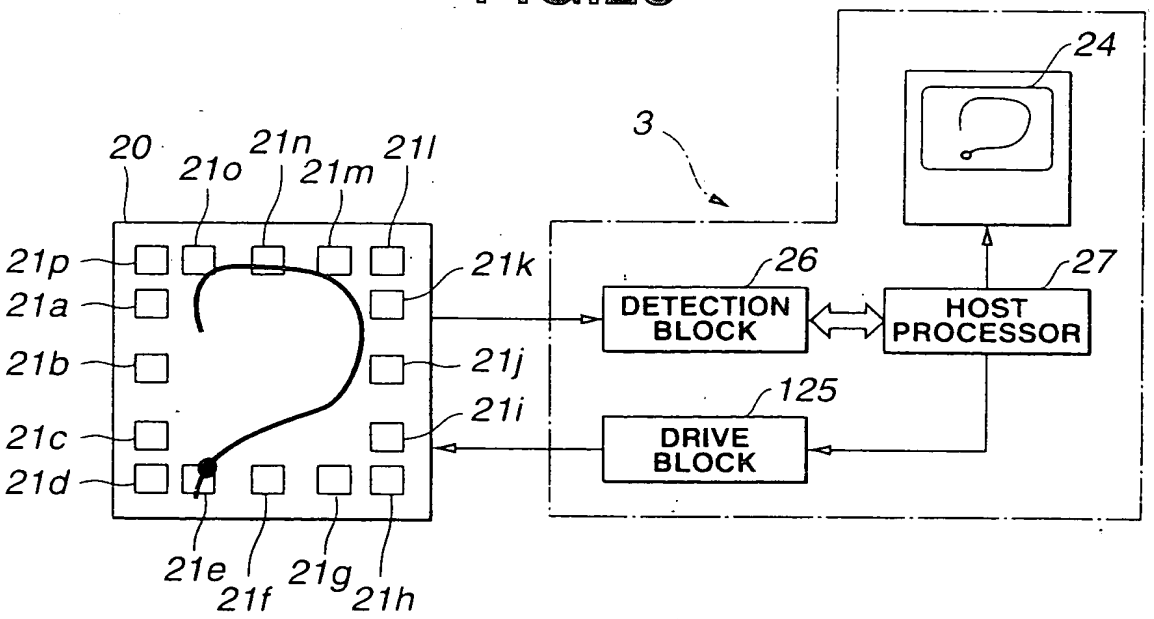

24
3
20
21o
21n
21m
21l
21p
21a
21b
21c
21d
21k
21j
21i
26
27
DETECTION BLOCK
HOST PROCESSOR
125
DRIVE BLOCK
21e
21f
21g
21h

FIG.24A

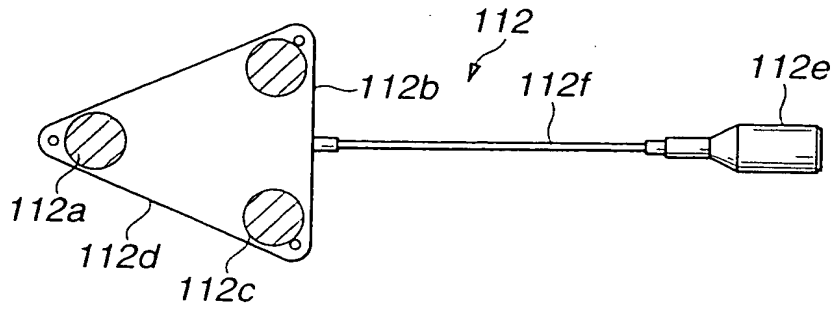


FIG.24B

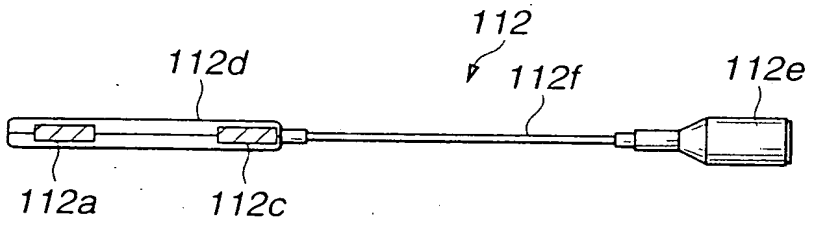


FIG.25

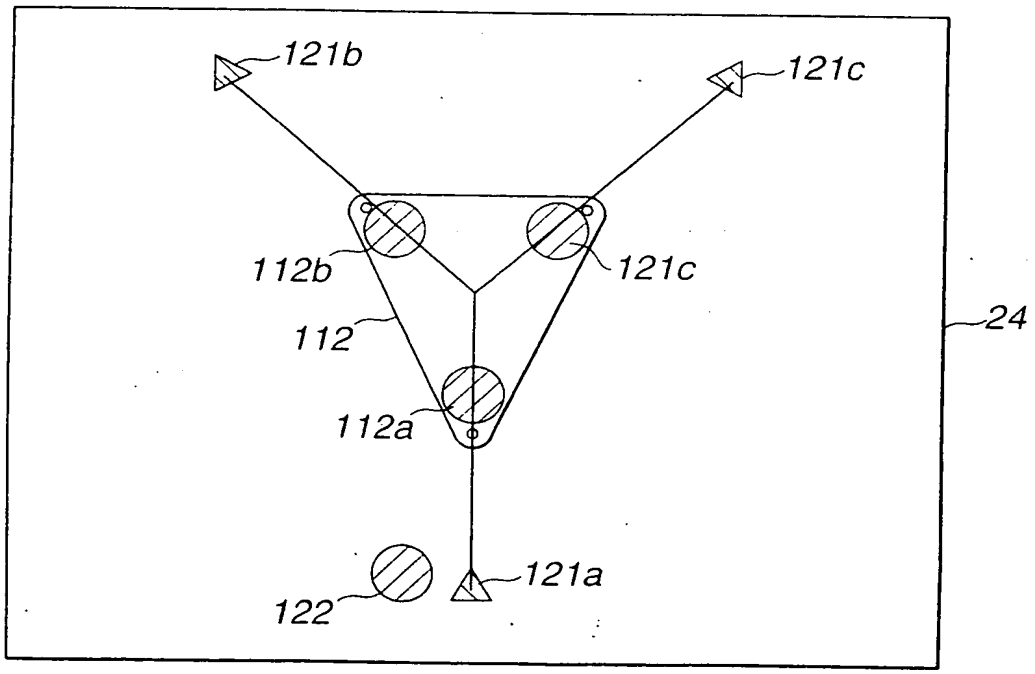


FIG.26

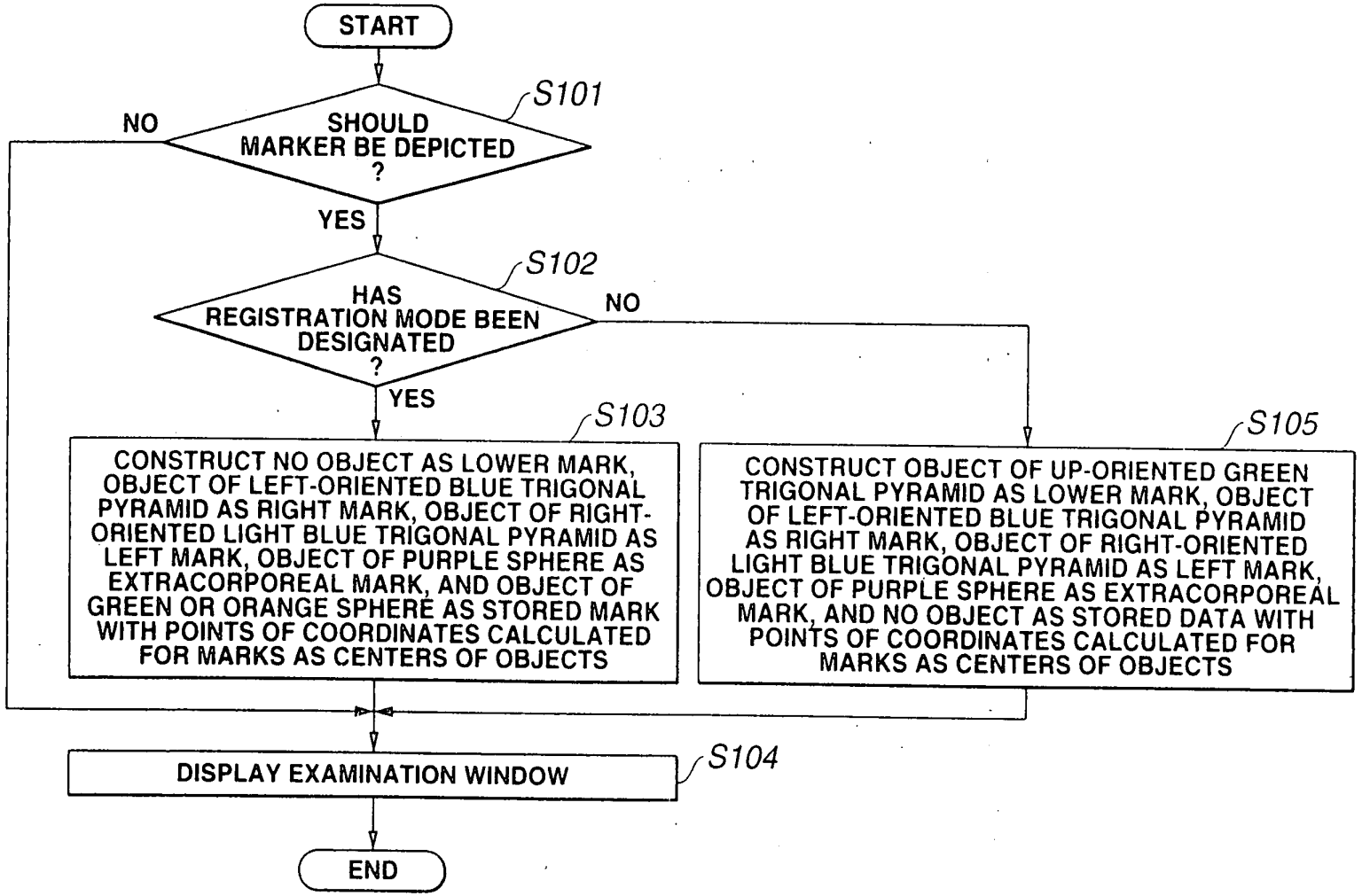

START
S101
SHOULD MARKER BE DEPICTED ?
NO
YES
S102
HAS REGISTRATION MODE BEEN DESIGNATED ?
NO
YES
S103
CONSTRUCT NO OBJECT AS LOWER MARK, OBJECT OF LEFT-ORIENTED BLUE TRIGONAL PYRAMID AS RIGHT MARK, OBJECT OF RIGHT-ORIENTED LIGHT BLUE TRIGONAL PYRAMID AS LEFT MARK, OBJECT OF PURPLE SPHERE AS EXTRACORPOREAL MARK, AND OBJECT OF GREEN OR ORANGE SPHERE AS STORED MARK WITH POINTS OF COORDINATES CALCULATED FOR MARKS AS CENTERS OF OBJECTS
S105
CONSTRUCT OBJECT OF UP-ORIENTED GREEN TRIGONAL PYRAMID AS LOWER MARK, OBJECT OF LEFT-ORIENTED BLUE TRIGONAL PYRAMID AS RIGHT MARK, OBJECT OF RIGHT-ORIENTED LIGHT BLUE TRIGONAL PYRAMID AS LEFT MARK, OBJECT OF PURPLE SPHERE AS EXTRACORPOREAL MARK, AND NO OBJECT AS STORED DATA WITH POINTS OF COORDINATES CALCULATED FOR MARKS AS CENTERS OF OBJECTS
DISPLAY EXAMINATION WINDOW
S104
END

FIG.27

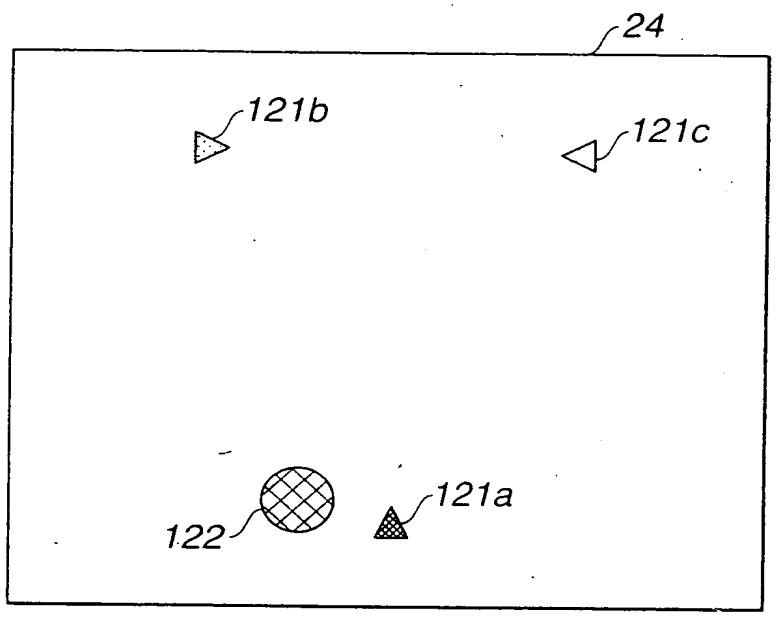


FIG.28A

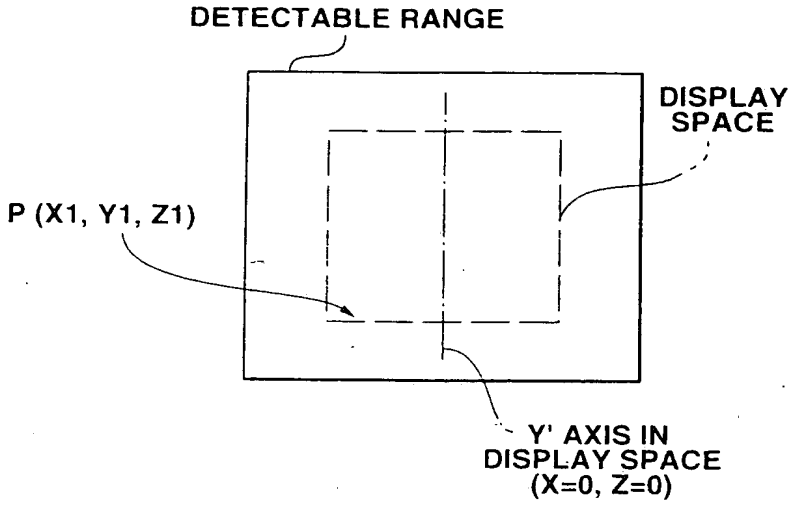


FIG.28B

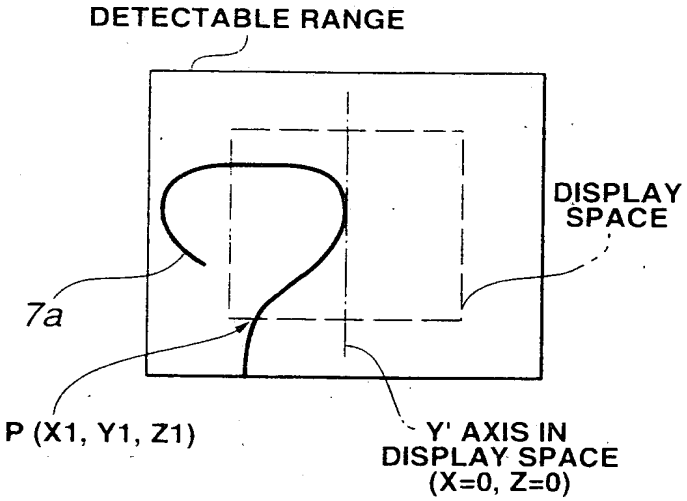


FIG.28C

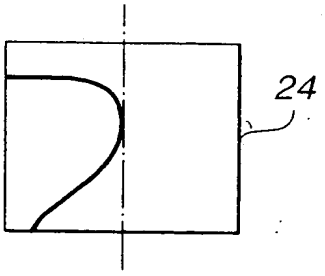


FIG.29

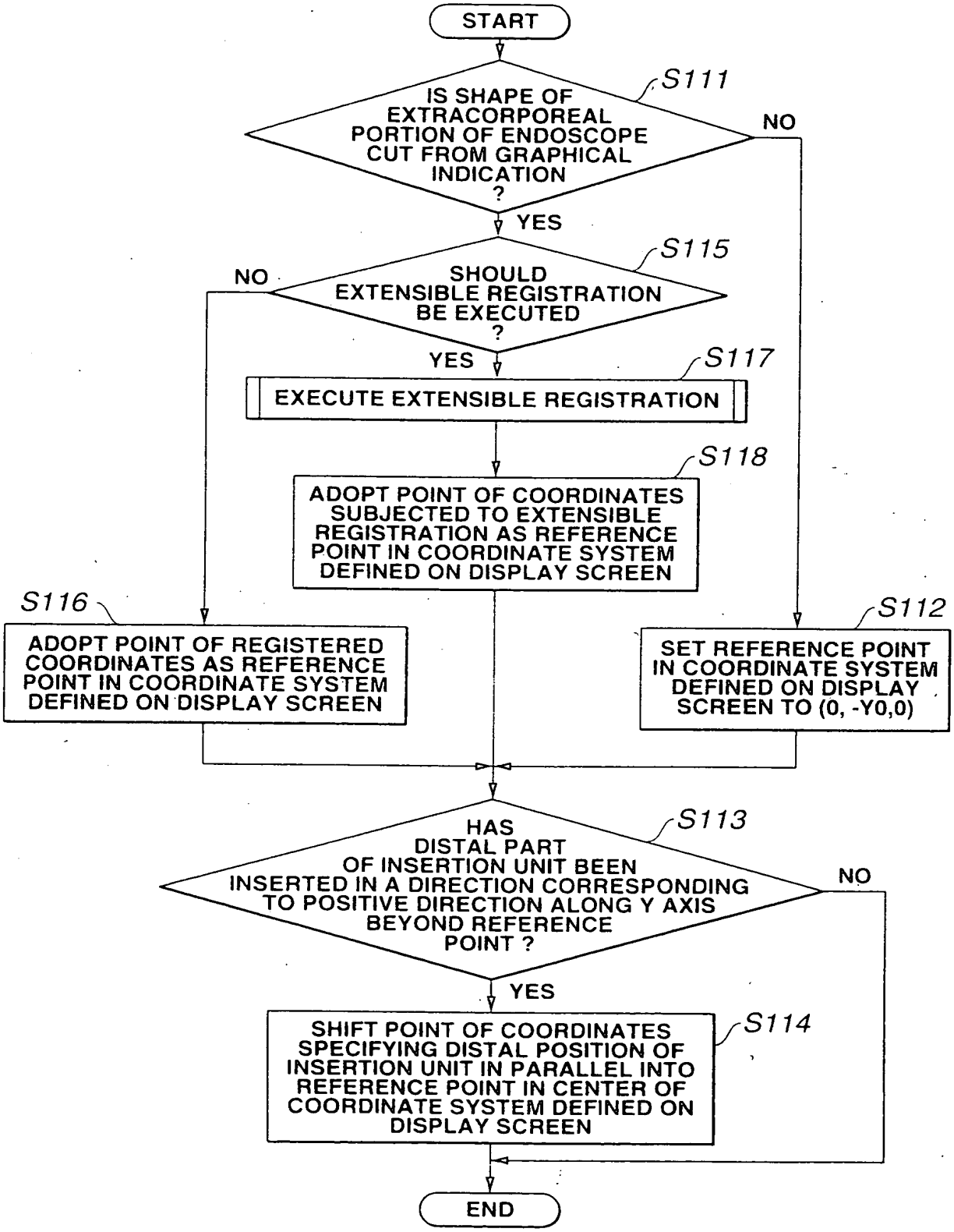

START
S111
IS SHAPE OF EXTRACORPOREAL PORTION OF ENDOSCOPE CUT FROM GRAPHICAL INDICATION ?
NO
YES
S115
SHOULD EXTENSIBLE REGISTRATION BE EXECUTED ?
NO
YES
S117
EXECUTE EXTENSIBLE REGISTRATION
S118
ADOPT POINT OF COORDINATES SUBJECTED TO EXTENSIBLE REGISTRATION AS REFERENCE POINT IN COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
S116
ADOPT POINT OF REGISTERED COORDINATES AS REFERENCE POINT IN COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
S112
SET REFERENCE POINT IN COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN TO (0, -Y0,0)
S113
HAS DISTAL PART OF INSERTION UNIT BEEN INSERTED IN A DIRECTION CORRESPONDING TO POSITIVE DIRECTION ALONG Y AXIS BEYOND REFERENCE POINT ?
NO
YES
S114
SHIFT POINT OF COORDINATES SPECIFYING DISTAL POSITION OF INSERTION UNIT IN PARALLEL INTO REFERENCE POINT IN CENTER OF COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
END

FIG.32

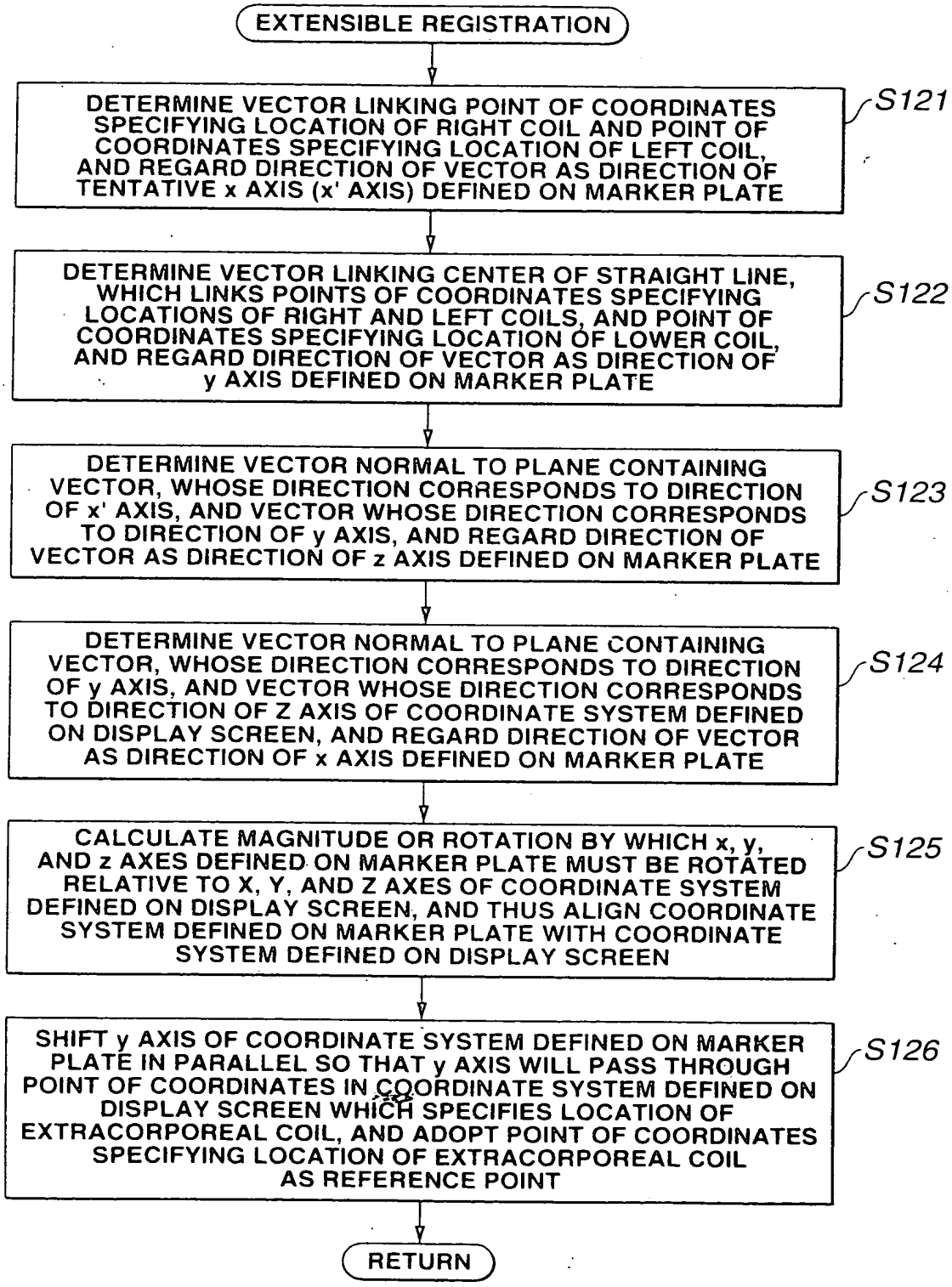

EXTENSIBLE REGISTRATION
DETERMINE VECTOR LINKING POINT OF COORDINATES SPECIFYING LOCATION OF RIGHT COIL AND POINT OF COORDINATES SPECIFYING LOCATION OF LEFT COIL, AND REGARD DIRECTION OF VECTOR AS DIRECTION OF TENTATIVE x AXIS (x' AXIS) DEFINED ON MARKER PLATE
S121
DETERMINE VECTOR LINKING CENTER OF STRAIGHT LINE, WHICH LINKS POINTS OF COORDINATES SPECIFYING LOCATIONS OF RIGHT AND LEFT COILS, AND POINT OF COORDINATES SPECIFYING LOCATION OF LOWER COIL, AND REGARD DIRECTION OF VECTOR AS DIRECTION OF y AXIS DEFINED ON MARKER PLATE
S122
DETERMINE VECTOR NORMAL TO PLANE CONTAINING VECTOR, WHOSE DIRECTION CORRESPONDS TO DIRECTION OF x' AXIS, AND VECTOR WHOSE DIRECTION CORRESPONDS TO DIRECTION OF y AXIS, AND REGARD DIRECTION OF VECTOR AS DIRECTION OF z AXIS DEFINED ON MARKER PLATE
S123
DETERMINE VECTOR NORMAL TO PLANE CONTAINING VECTOR, WHOSE DIRECTION CORRESPONDS TO DIRECTION OF y AXIS, AND VECTOR WHOSE DIRECTION CORRESPONDS TO DIRECTION OF Z AXIS OF COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN, AND REGARD DIRECTION OF VECTOR AS DIRECTION OF x AXIS DEFINED ON MARKER PLATE
S124
CALCULATE MAGNITUDE OR ROTATION BY WHICH x, y, AND z AXES DEFINED ON MARKER PLATE MUST BE ROTATED RELATIVE TO X, Y, AND Z AXES OF COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN, AND THUS ALIGN COORDINATE SYSTEM DEFINED ON MARKER PLATE WITH COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
S125
SHIFT y AXIS OF COORDINATE SYSTEM DEFINED ON MARKER PLATE IN PARALLEL SO THAT y AXIS WILL PASS THROUGH POINT OF COORDINATES IN COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN WHICH SPECIFIES LOCATION OF EXTRACORPOREAL COIL, AND ADOPT POINT OF COORDINATES SPECIFYING LOCATION OF EXTRACORPOREAL COIL AS REFERENCE POINT
S126
RETURN

FIG.30A

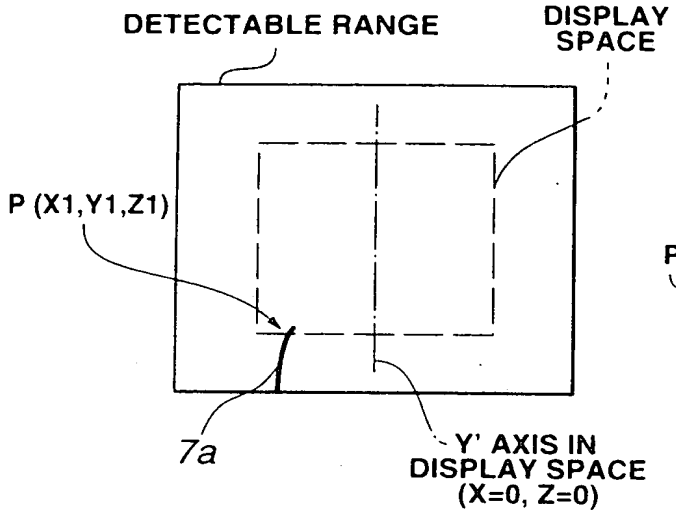


FIG.30B

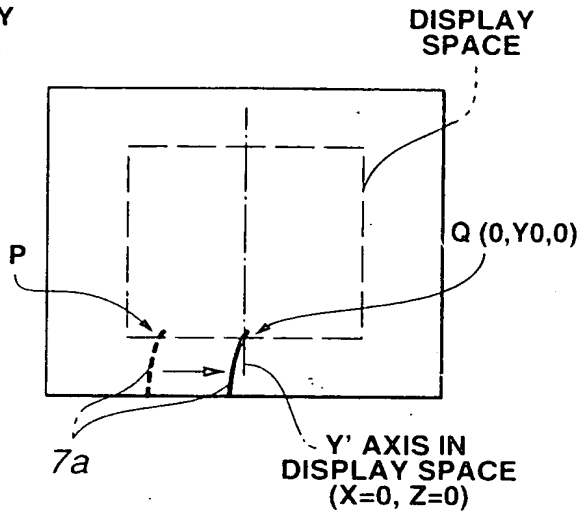


FIG.30C

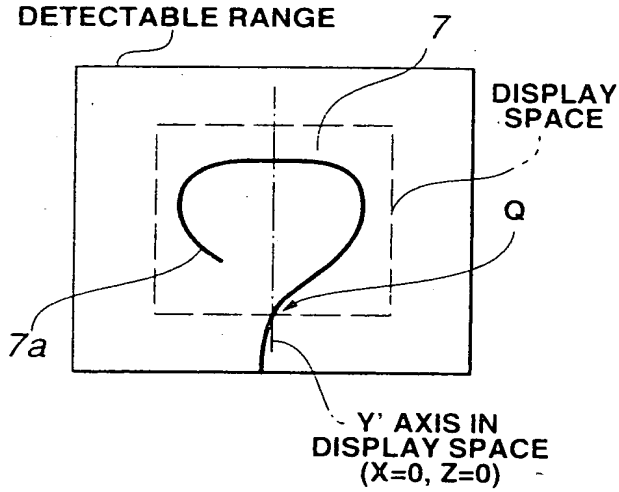


FIG.30D

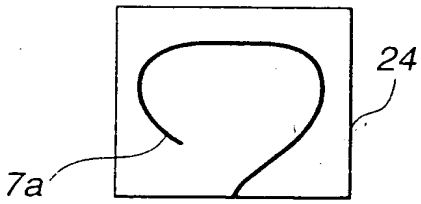


FIG.31A

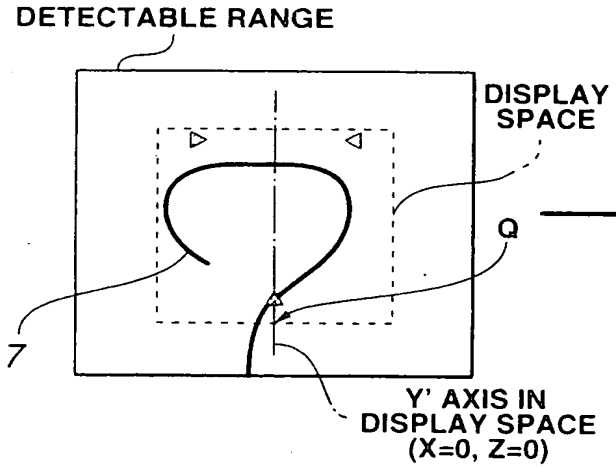


FIG.31B

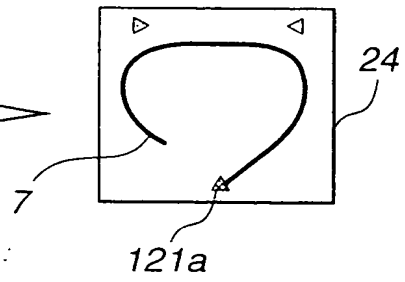


FIG.33

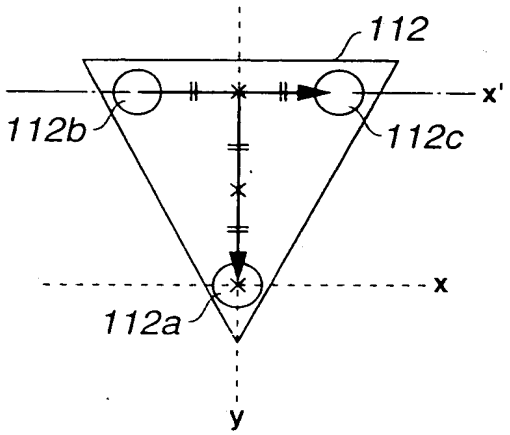


FIG.34

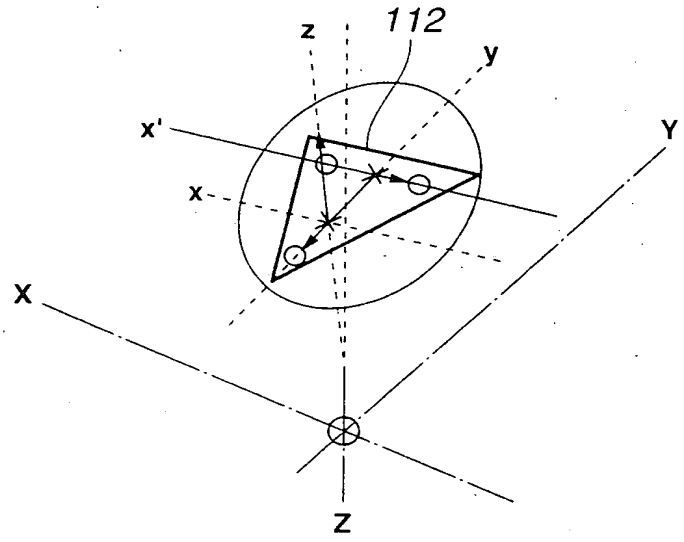


FIG.35

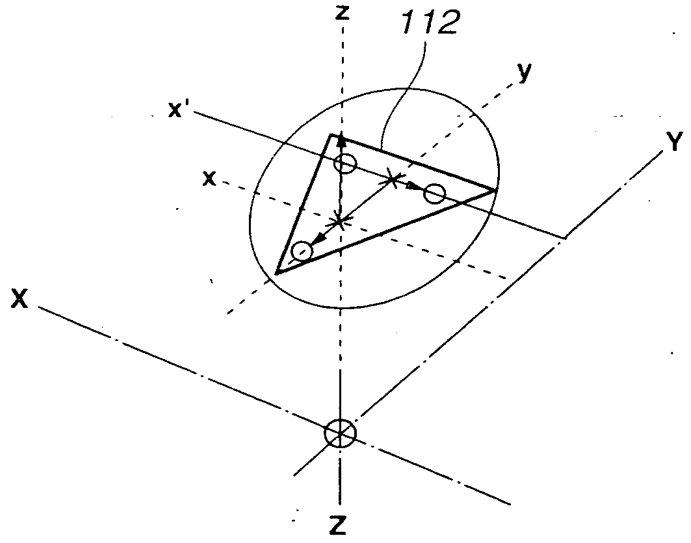


FIG.36

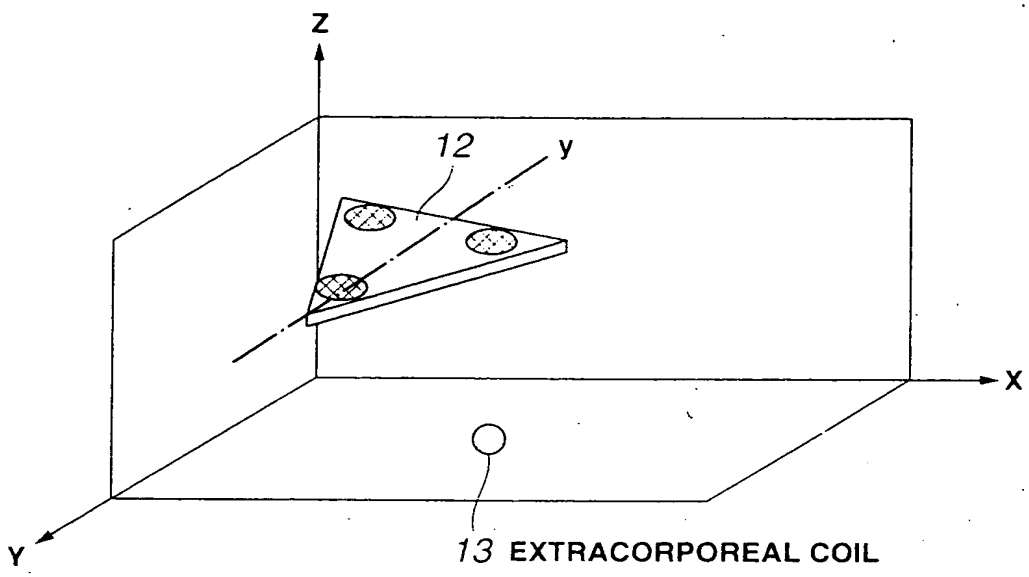

Z
12
y
X
Y
13 EXTRACORPOREAL COIL

FIG.37

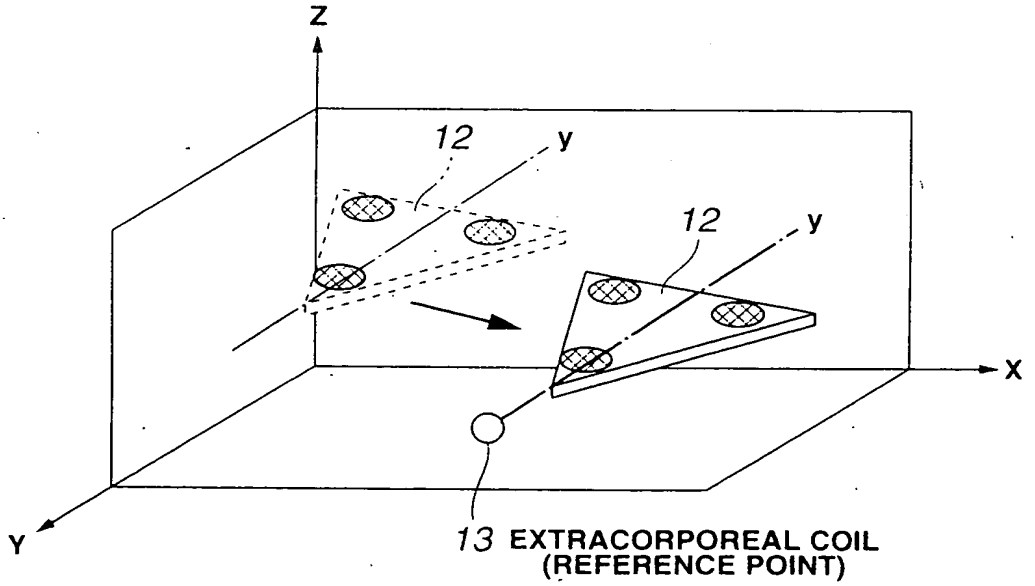

Z
12
y
12
y
X
Y
13 EXTRACORPOREAL COIL
(REFERENCE POINT)

FIG.38

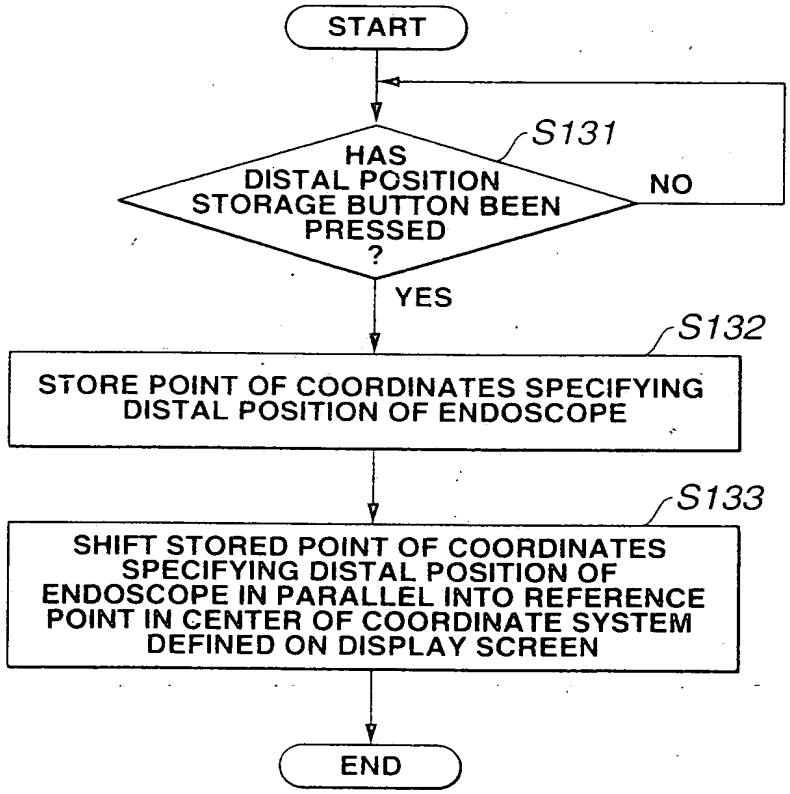

START
S131
HAS DISTAL POSITION STORAGE BUTTON BEEN PRESSED ?
NO
YES
S132
STORE POINT OF COORDINATES SPECIFYING DISTAL POSITION OF ENDOSCOPE
S133
SHIFT STORED POINT OF COORDINATES SPECIFYING DISTAL POSITION OF ENDOSCOPE IN PARALLEL INTO REFERENCE POINT IN CENTER OF COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
END

FIG.39

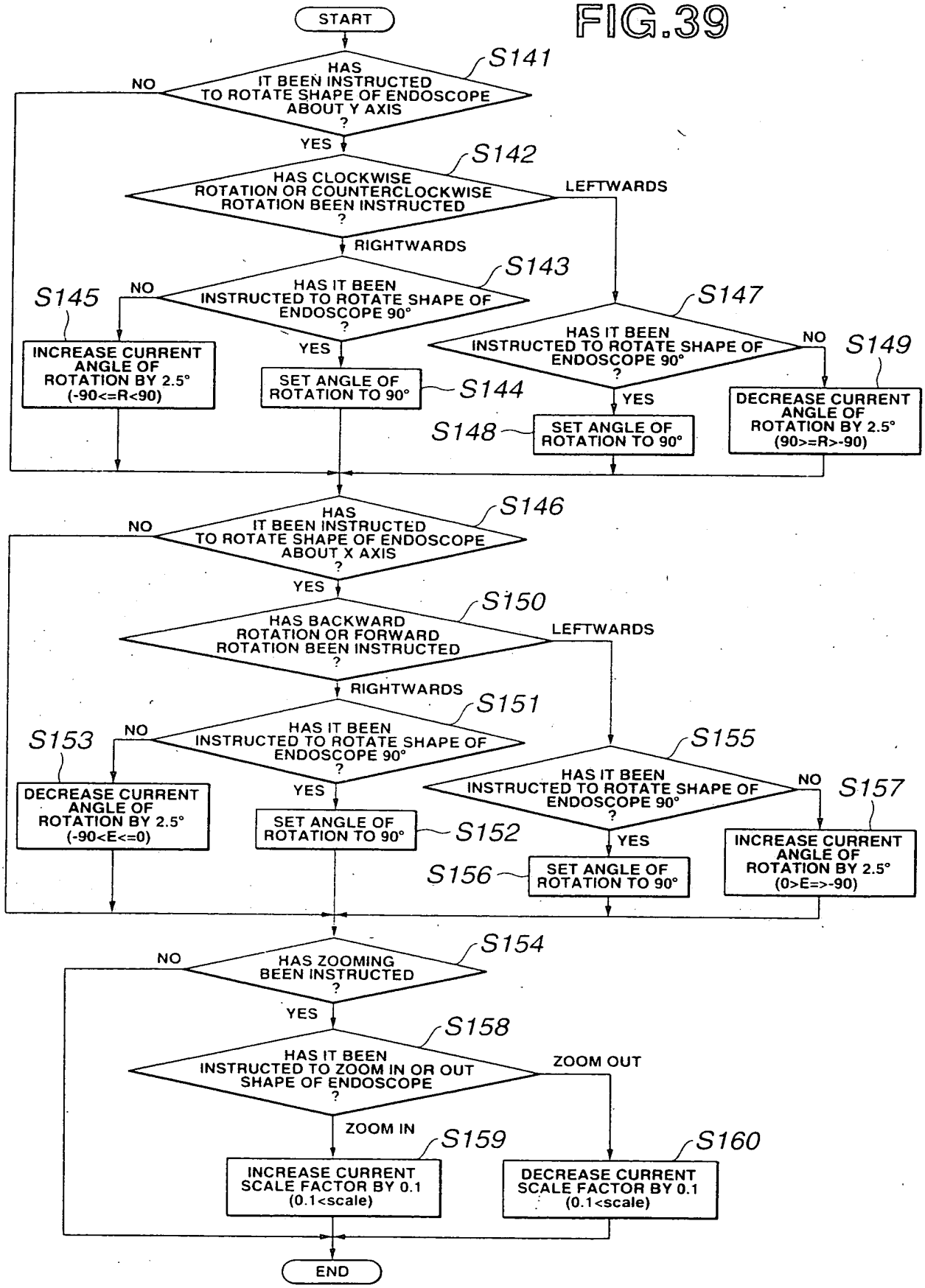

START
S141
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE ABOUT Y AXIS ?
NO
YES
S142
HAS CLOCKWISE ROTATION OR COUNTERCLOCKWISE ROTATION BEEN INSTRUCTED ?
LEFTWARDS
RIGHTWARDS
S143
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE 90° ?
NO
YES
S145
INCREASE CURRENT ANGLE OF ROTATION BY 2.5° (-90<=R<90)
SET ANGLE OF ROTATION TO 90°
S144
S147
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE 90° ?
NO
YES
S149
DECREASE CURRENT ANGLE OF ROTATION BY 2.5° (90>=R>-90)
S148
SET ANGLE OF ROTATION TO 90°
S146
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE ABOUT X AXIS ?
NO
YES
S150
HAS BACKWARD ROTATION OR FORWARD ROTATION BEEN INSTRUCTED ?
LEFTWARDS
RIGHTWARDS
S151
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE 90° ?
NO
YES
S153
DECREASE CURRENT ANGLE OF ROTATION BY 2.5° (-90<E<=0)
SET ANGLE OF ROTATION TO 90°
S152
S155
HAS IT BEEN INSTRUCTED TO ROTATE SHAPE OF ENDOSCOPE 90° ?
NO
YES
S157
INCREASE CURRENT ANGLE OF ROTATION BY 2.5° (0>E=>-90)
S156
SET ANGLE OF ROTATION TO 90°
S154
HAS ZOOMING BEEN INSTRUCTED ?
NO
YES
S158
HAS IT BEEN INSTRUCTED TO ZOOM IN OR OUT SHAPE OF ENDOSCOPE ?
ZOOM OUT
ZOOM IN
S159
INCREASE CURRENT SCALE FACTOR BY 0.1 (0.1<scale)
S160
DECREASE CURRENT SCALE FACTOR BY 0.1 (0.1<scale)
END

FIG.40

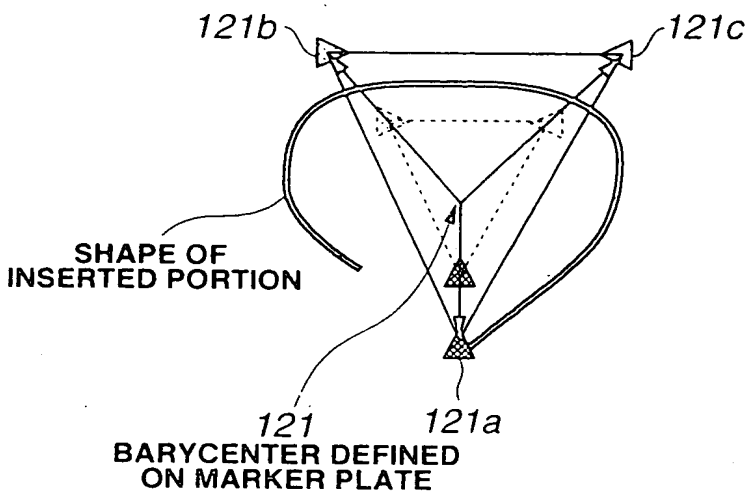

121b
121c
SHAPE OF
INSERTED PORTION
121
121a
BARYCENTER DEFINED
ON MARKER PLATE

FIG.42

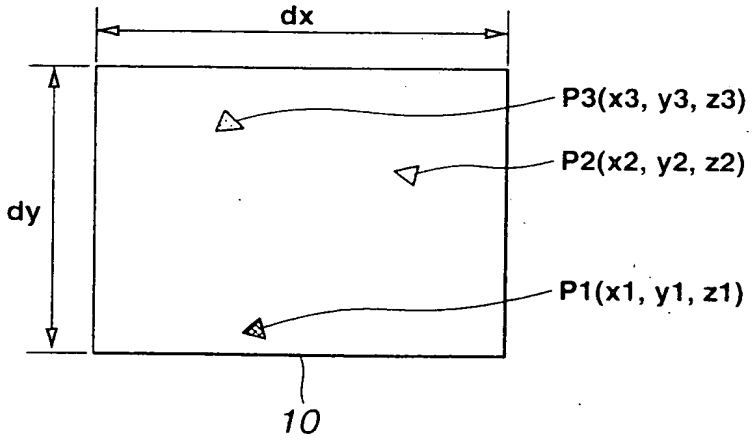

dx
dy
P3(x3, y3, z3)
P2(x2, y2, z2)
P1(x1, y1, z1)
10

FIG.41

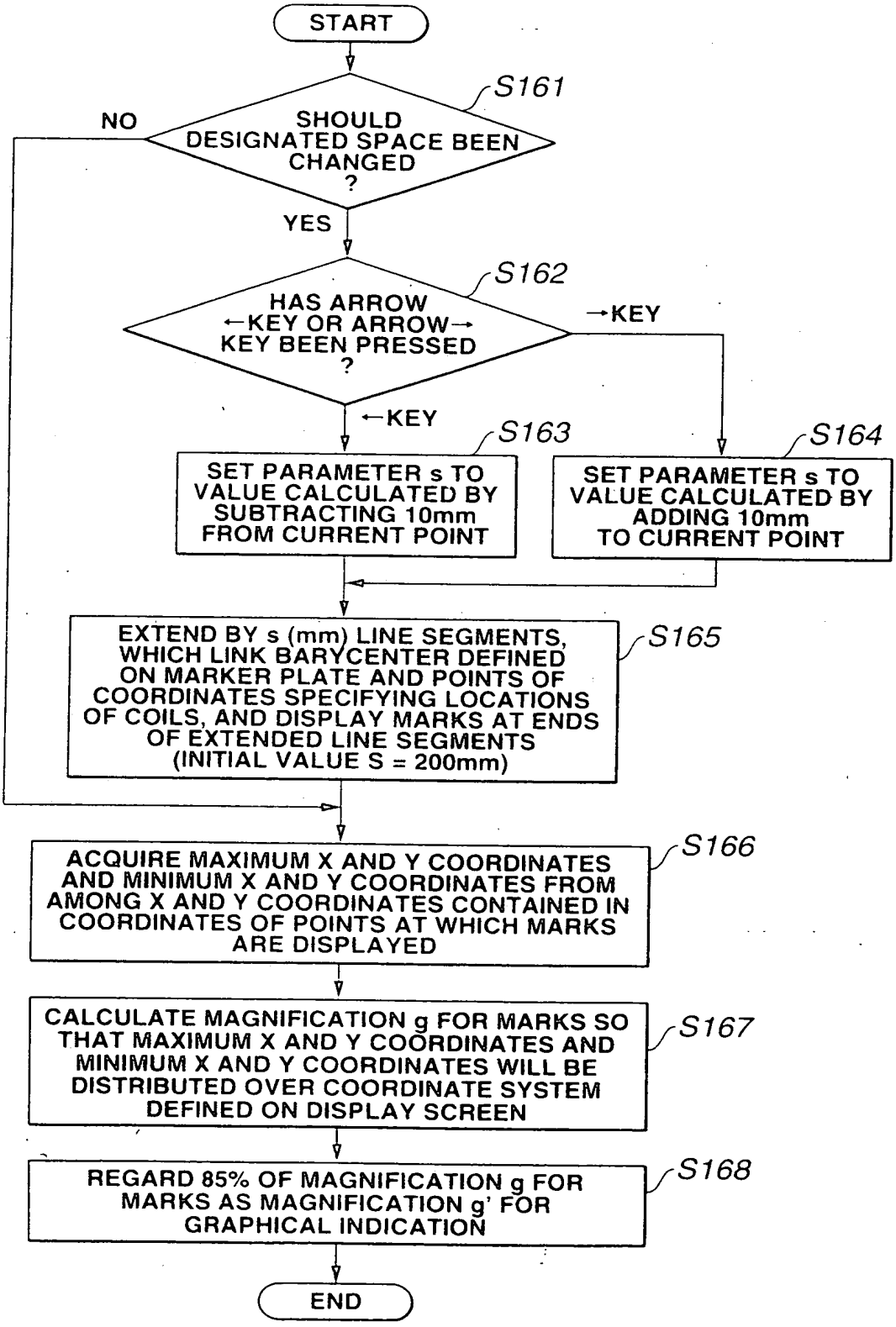

START
S161
SHOULD DESIGNATED SPACE BEEN CHANGED ?
NO
YES
S162
HAS ARROW ←KEY OR ARROW→ KEY BEEN PRESSED ?
→KEY
←KEY
S163
SET PARAMETER s TO VALUE CALCULATED BY SUBTRACTING 10mm FROM CURRENT POINT
S164
SET PARAMETER s TO VALUE CALCULATED BY ADDING 10mm TO CURRENT POINT
EXTEND BY s (mm) LINE SEGMENTS, WHICH LINK BARYCENTER DEFINED ON MARKER PLATE AND POINTS OF COORDINATES SPECIFYING LOCATIONS OF COILS, AND DISPLAY MARKS AT ENDS OF EXTENDED LINE SEGMENTS (INITIAL VALUE S = 200mm)
S165
ACQUIRE MAXIMUM X AND Y COORDINATES AND MINIMUM X AND Y COORDINATES FROM AMONG X AND Y COORDINATES CONTAINED IN COORDINATES OF POINTS AT WHICH MARKS ARE DISPLAYED
S166
CALCULATE MAGNIFICATION g FOR MARKS SO THAT MAXIMUM X AND Y COORDINATES AND MINIMUM X AND Y COORDINATES WILL BE DISTRIBUTED OVER COORDINATE SYSTEM DEFINED ON DISPLAY SCREEN
S167
REGARD 85% OF MAGNIFICATION g FOR MARKS AS MAGNIFICATION g' FOR GRAPHICAL INDICATION
S168
END

FIG.43

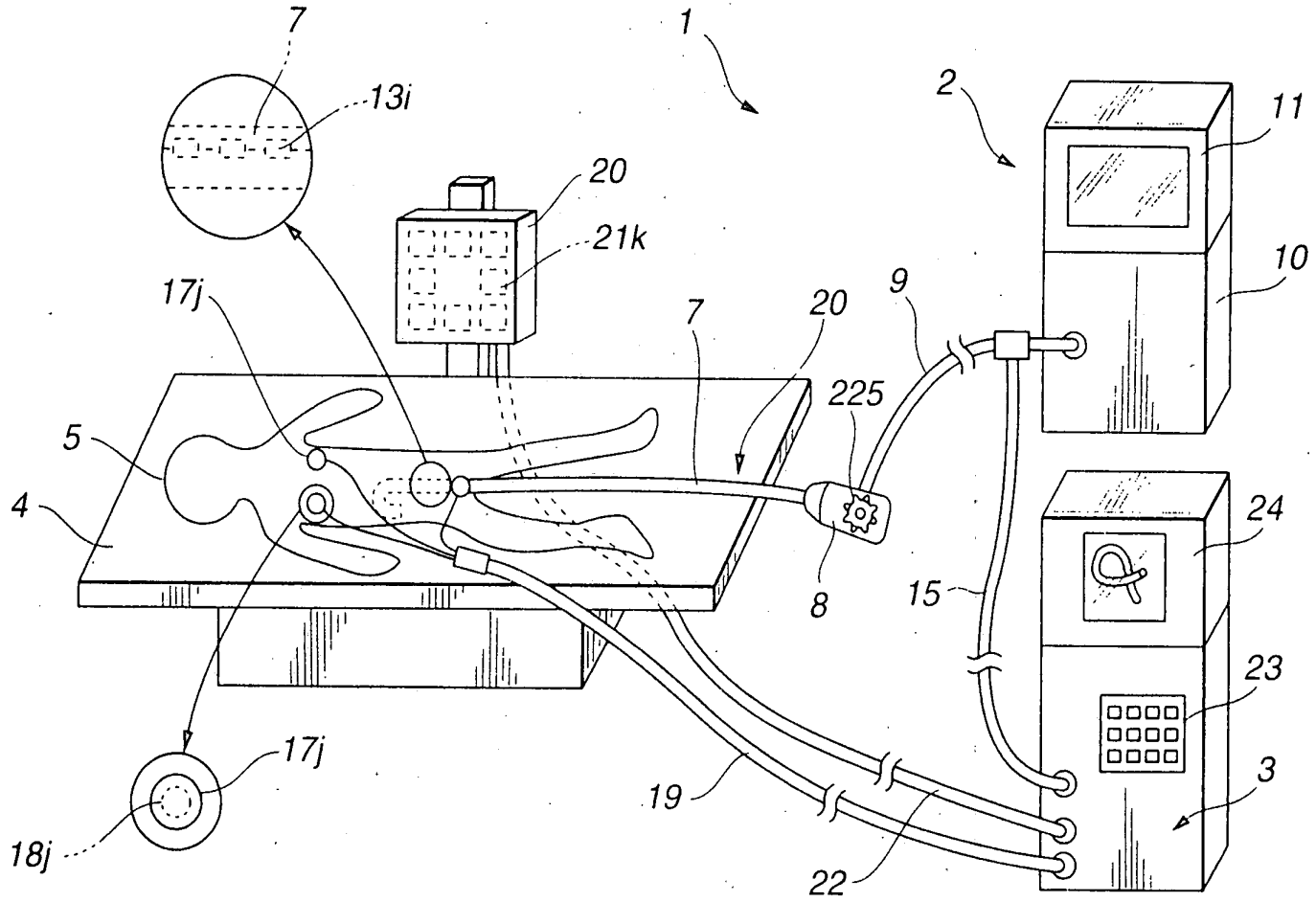


FIG.44

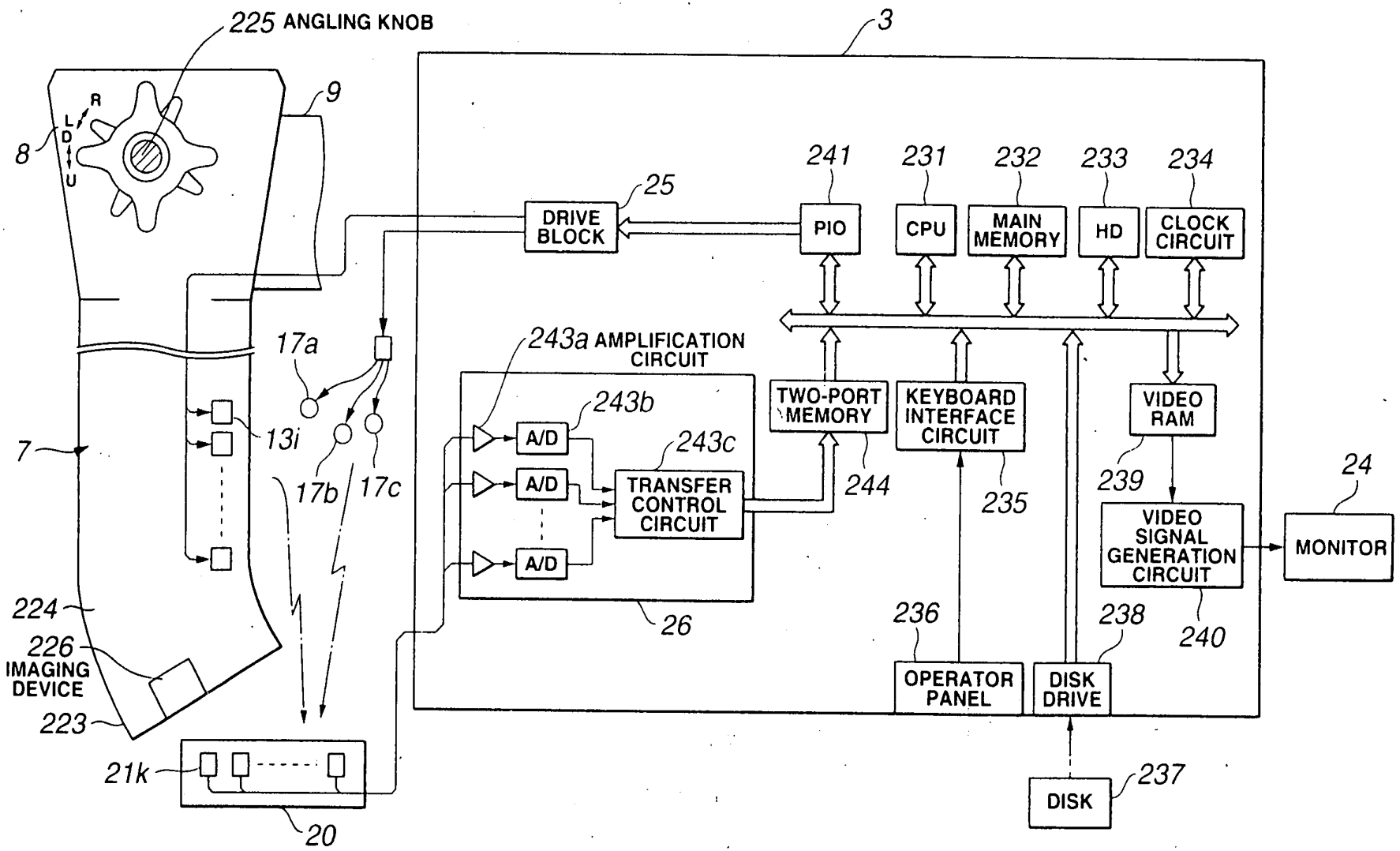

225 ANGLING KNOB
3
9
8
R
L
D
U
241
231
232
233
234
25
DRIVE BLOCK
PIO
CPU
MAIN MEMORY
HD
CLOCK CIRCUIT
17a
243a AMPLIFICATION CIRCUIT
243b
A/D
A/D
A/D
243c
TRANSFER CONTROL CIRCUIT
TWO-PORT MEMORY
244
KEYBOARD INTERFACE CIRCUIT
235
VIDEO RAM
239
VIDEO SIGNAL GENERATION CIRCUIT
240
24
MONITOR
7
13i
17b
17c
26
224
226
IMAGING DEVICE
223
236
OPERATOR PANEL
238
DISK DRIVE
21k
20
DISK
237

FIG.45

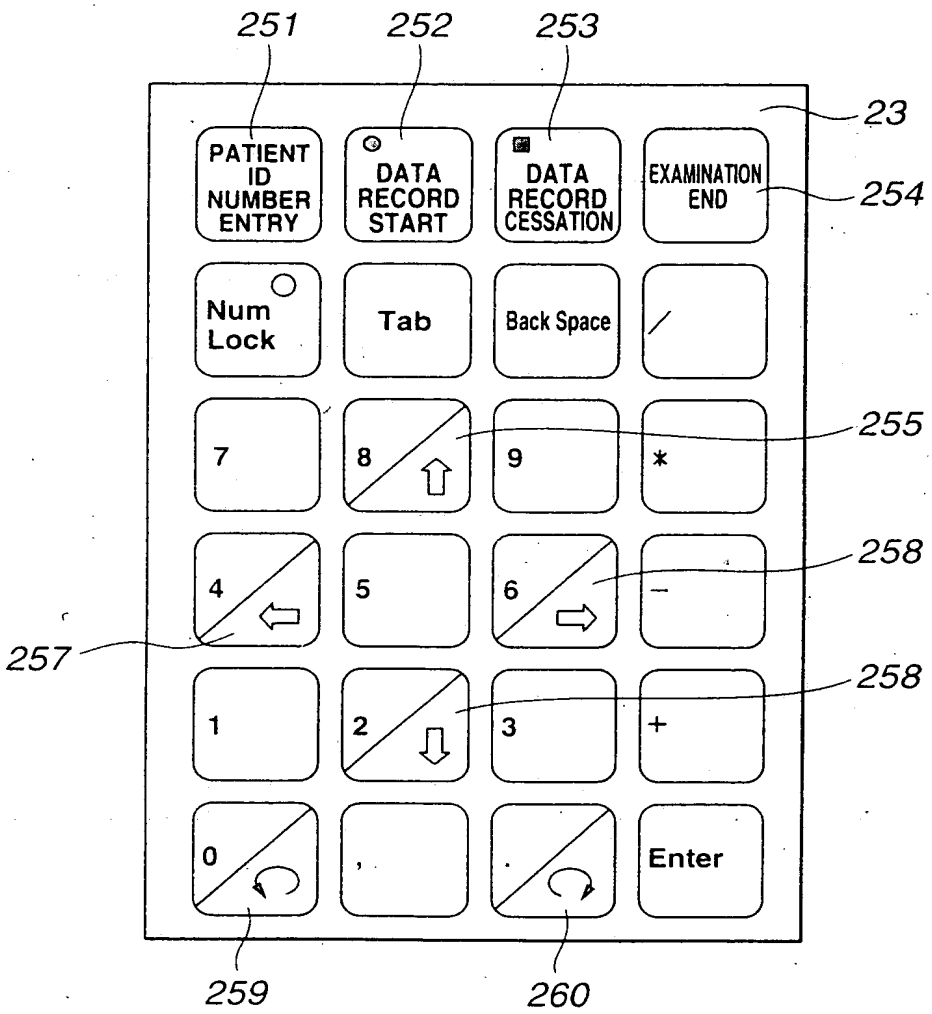

251
252
253
23
PATIENT ID NUMBER ENTRY
DATA RECORD START
DATA RECORD CESSATION
EXAMINATION END
254
Num Lock
Tab
Back Space
/
7
8
9
*
255
4
5
6
-
258
257
1
2
3
+
258
0
,
.
Enter
259
260

FIG.46

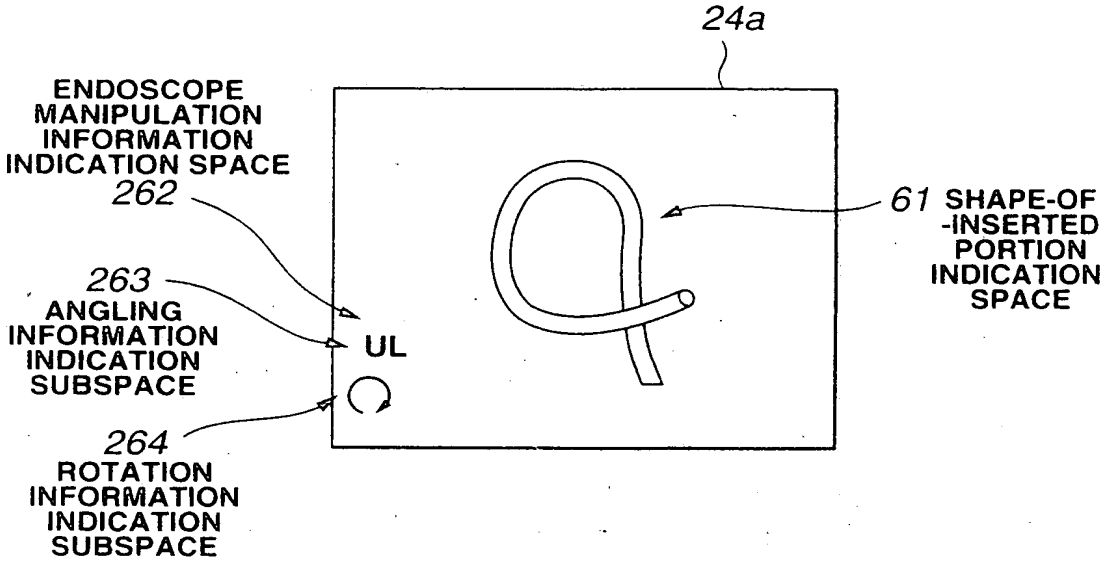

24a
ENDOSCOPE MANIPULATION INFORMATION INDICATION SPACE
262
263
ANGLING INFORMATION INDICATION SUBSPACE
264
ROTATION INFORMATION INDICATION SUBSPACE
UL
61
SHAPE-OF-INSERTED PORTION INDICATION SPACE

FIG.47

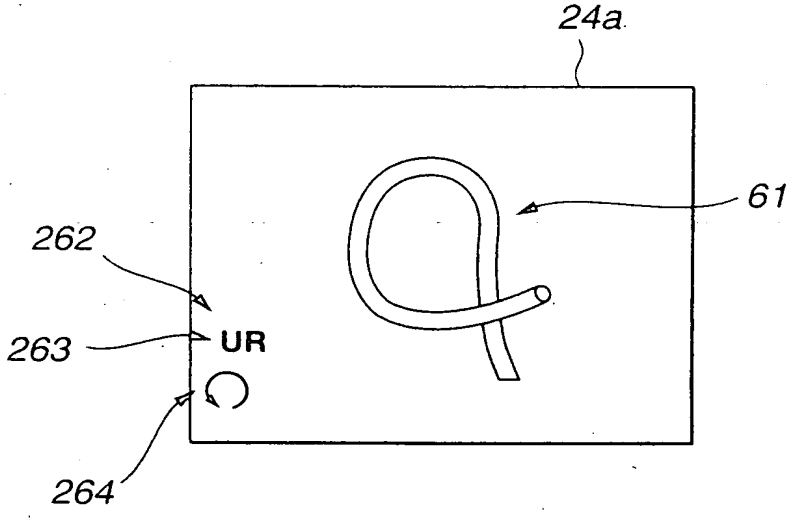

24a
61
262
263
UR
264

FIG.48

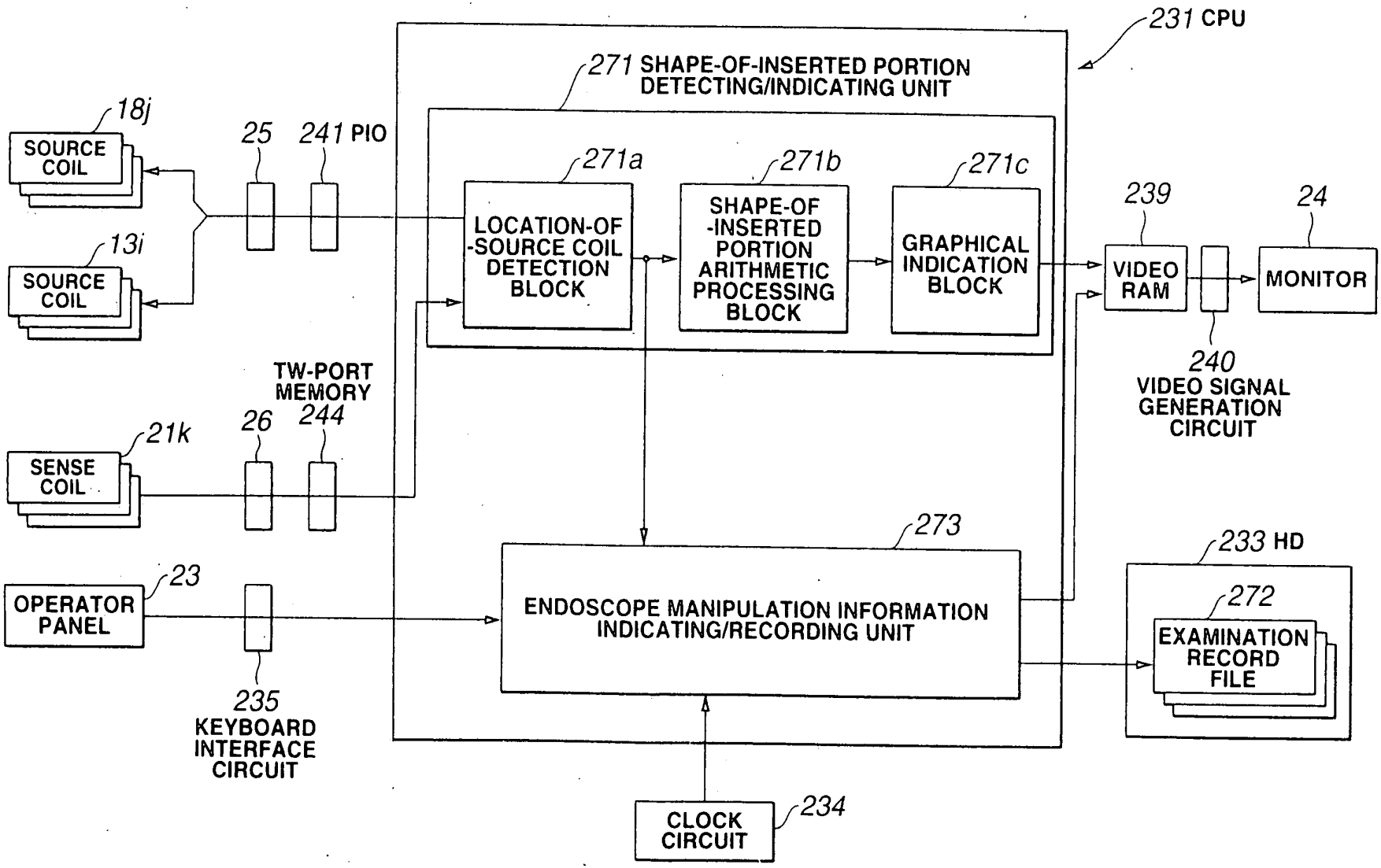

231 CPU
271 SHAPE-OF-INSERTED PORTION DETECTING/INDICATING UNIT
18j
SOURCE COIL
13i
SOURCE COIL
25
241 PIO
271a
LOCATION-OF -SOURCE COIL DETECTION BLOCK
271b
SHAPE-OF -INSERTED PORTION ARITHMETIC PROCESSING BLOCK
271c
GRAPHICAL INDICATION BLOCK
239
VIDEO RAM
24
MONITOR
240
VIDEO SIGNAL GENERATION CIRCUIT
TW-PORT MEMORY
26
244
21k
SENSE COIL
273
ENDOSCOPE MANIPULATION INFORMATION INDICATING/RECORDING UNIT
233 HD
272
EXAMINATION RECORD FILE
23
OPERATOR PANEL
235
KEYBOARD INTERFACE CIRCUIT
CLOCK CIRCUIT
234

FIG.49A

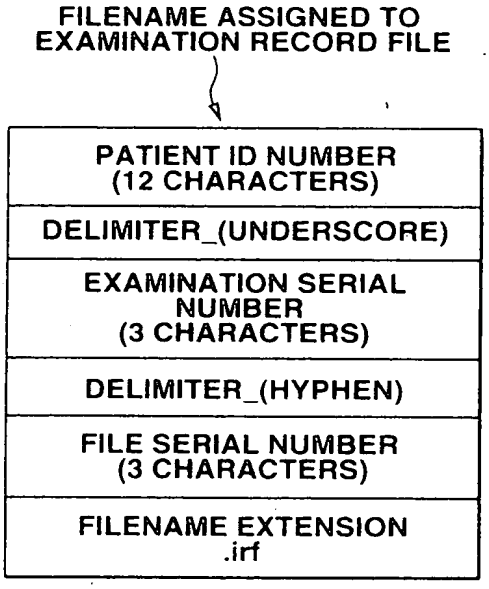


FIG.49B

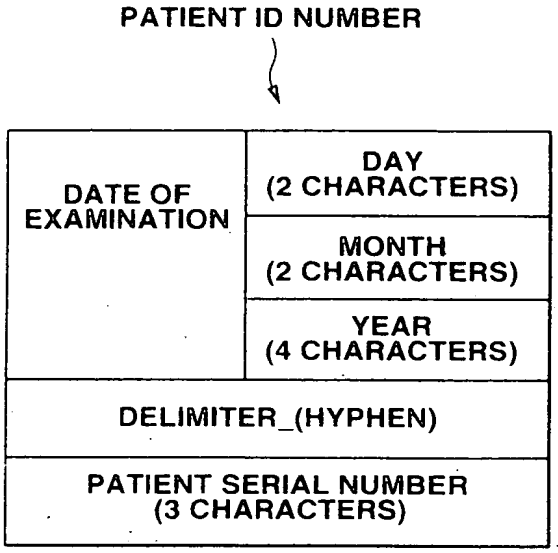


FIG.51

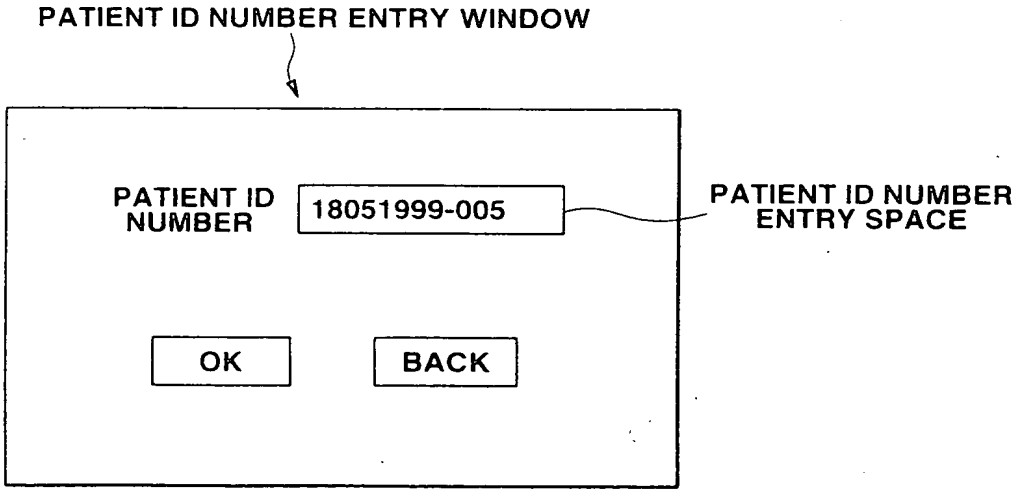


FIG.50

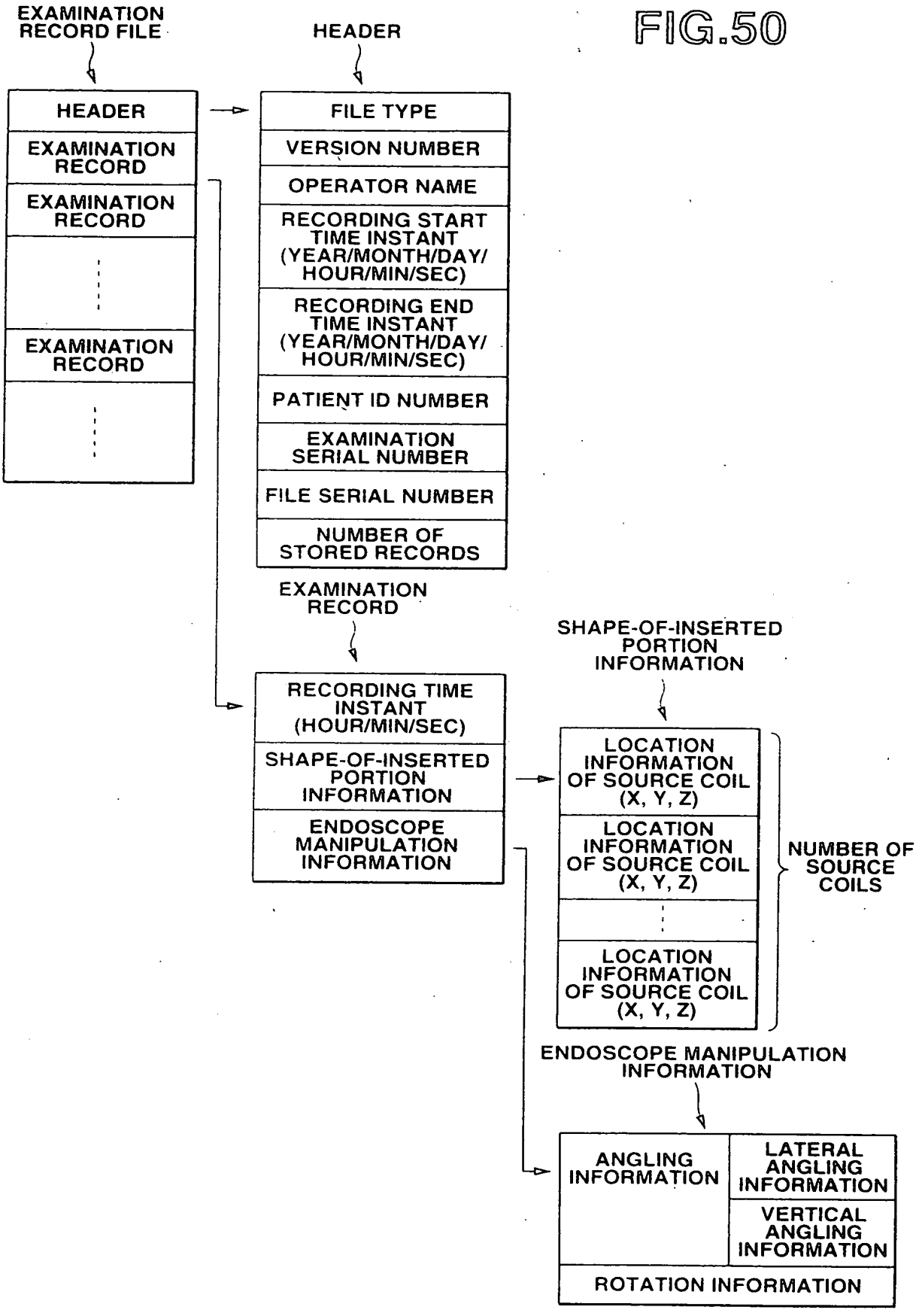

EXAMINATION RECORD FILE
HEADER
EXAMINATION RECORD
EXAMINATION RECORD
EXAMINATION RECORD
HEADER
FILE TYPE
VERSION NUMBER
OPERATOR NAME
RECORDING START TIME INSTANT (YEAR/MONTH/DAY/ HOUR/MIN/SEC)
RECORDING END TIME INSTANT (YEAR/MONTH/DAY/ HOUR/MIN/SEC)
PATIENT ID NUMBER
EXAMINATION SERIAL NUMBER
FILE SERIAL NUMBER
NUMBER OF STORED RECORDS
EXAMINATION RECORD
RECORDING TIME INSTANT (HOUR/MIN/SEC)
SHAPE-OF-INSERTED PORTION INFORMATION
ENDOSCOPE MANIPULATION INFORMATION
SHAPE-OF-INSERTED PORTION INFORMATION
LOCATION INFORMATION OF SOURCE COIL (X, Y, Z)
LOCATION INFORMATION OF SOURCE COIL (X, Y, Z)
LOCATION INFORMATION OF SOURCE COIL (X, Y, Z)
NUMBER OF SOURCE COILS
ENDOSCOPE MANIPULATION INFORMATION
ANGLING INFORMATION
LATERAL ANGLING INFORMATION
VERTICAL ANGLING INFORMATION
ROTATION INFORMATION

FIG.52

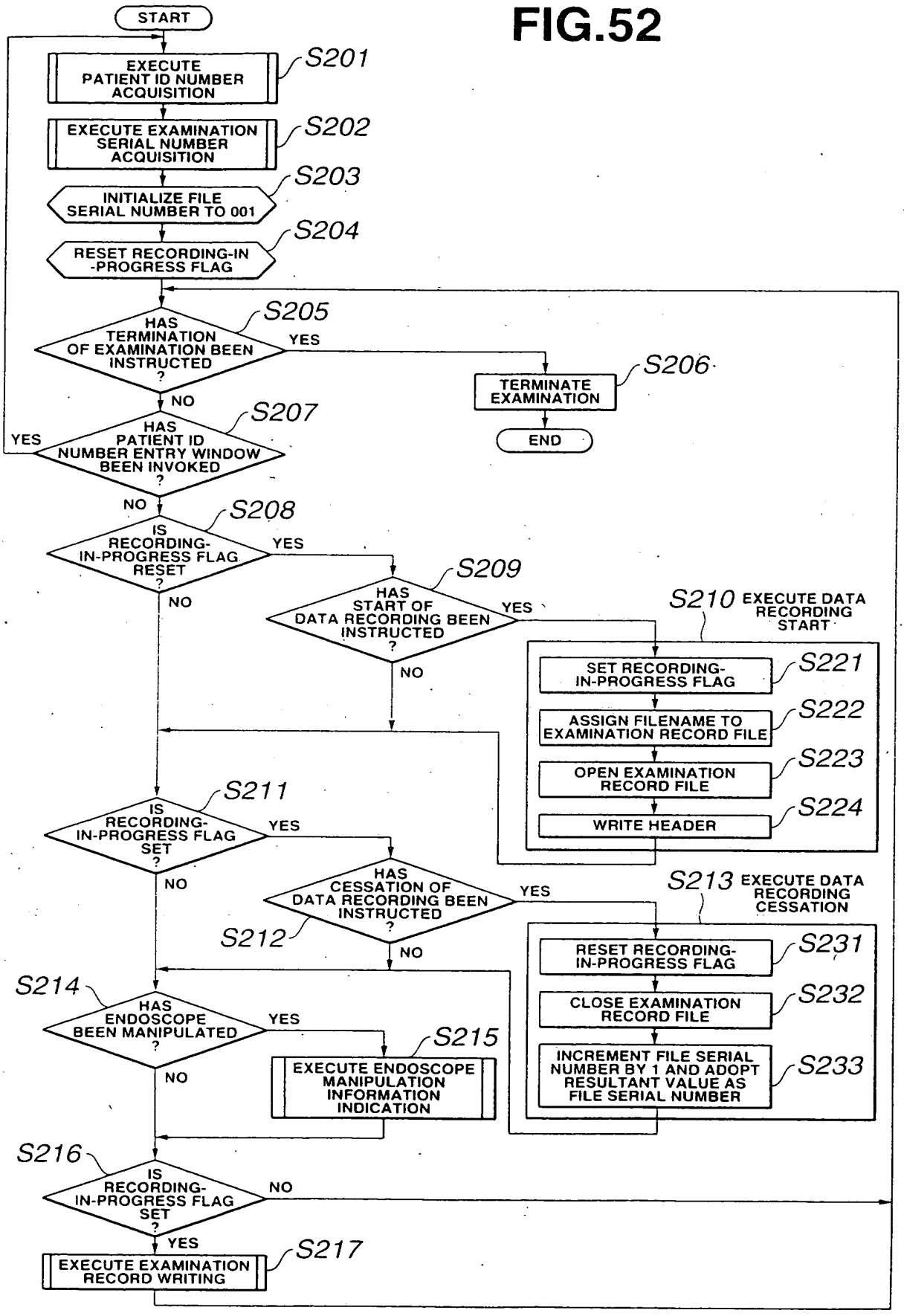

START
EXECUTE PATIENT ID NUMBER ACQUISITION
S201
EXECUTE EXAMINATION SERIAL NUMBER ACQUISITION
S202
INITIALIZE FILE SERIAL NUMBER TO 001
S203
RESET RECORDING-IN-PROGRESS FLAG
S204
HAS TERMINATION OF EXAMINATION BEEN INSTRUCTED ?
S205
YES
TERMINATE EXAMINATION
S206
END
NO
HAS PATIENT ID NUMBER ENTRY WINDOW BEEN INVOKED ?
S207
YES
NO
IS RECORDING-IN-PROGRESS FLAG RESET ?
S208
YES
NO
HAS START OF DATA RECORDING BEEN INSTRUCTED ?
S209
YES
NO
S210 EXECUTE DATA RECORDING START
SET RECORDING-IN-PROGRESS FLAG
S221
ASSIGN FILENAME TO EXAMINATION RECORD FILE
S222
OPEN EXAMINATION RECORD FILE
S223
WRITE HEADER
S224
IS RECORDING-IN-PROGRESS FLAG SET ?
S211
YES
NO
HAS CESSATION OF DATA RECORDING BEEN INSTRUCTED ?
S212
YES
NO
S213 EXECUTE DATA RECORDING CESSATION
RESET RECORDING-IN-PROGRESS FLAG
S231
CLOSE EXAMINATION RECORD FILE
S232
INCREMENT FILE SERIAL NUMBER BY 1 AND ADOPT RESULTANT VALUE AS FILE SERIAL NUMBER
S233
HAS ENDOSCOPE BEEN MANIPULATED ?
S214
YES
NO
EXECUTE ENDOSCOPE MANIPULATION INFORMATION INDICATION
S215
IS RECORDING-IN-PROGRESS FLAG SET ?
S216
NO
YES
EXECUTE EXAMINATION RECORD WRITING
S217

FIG.53

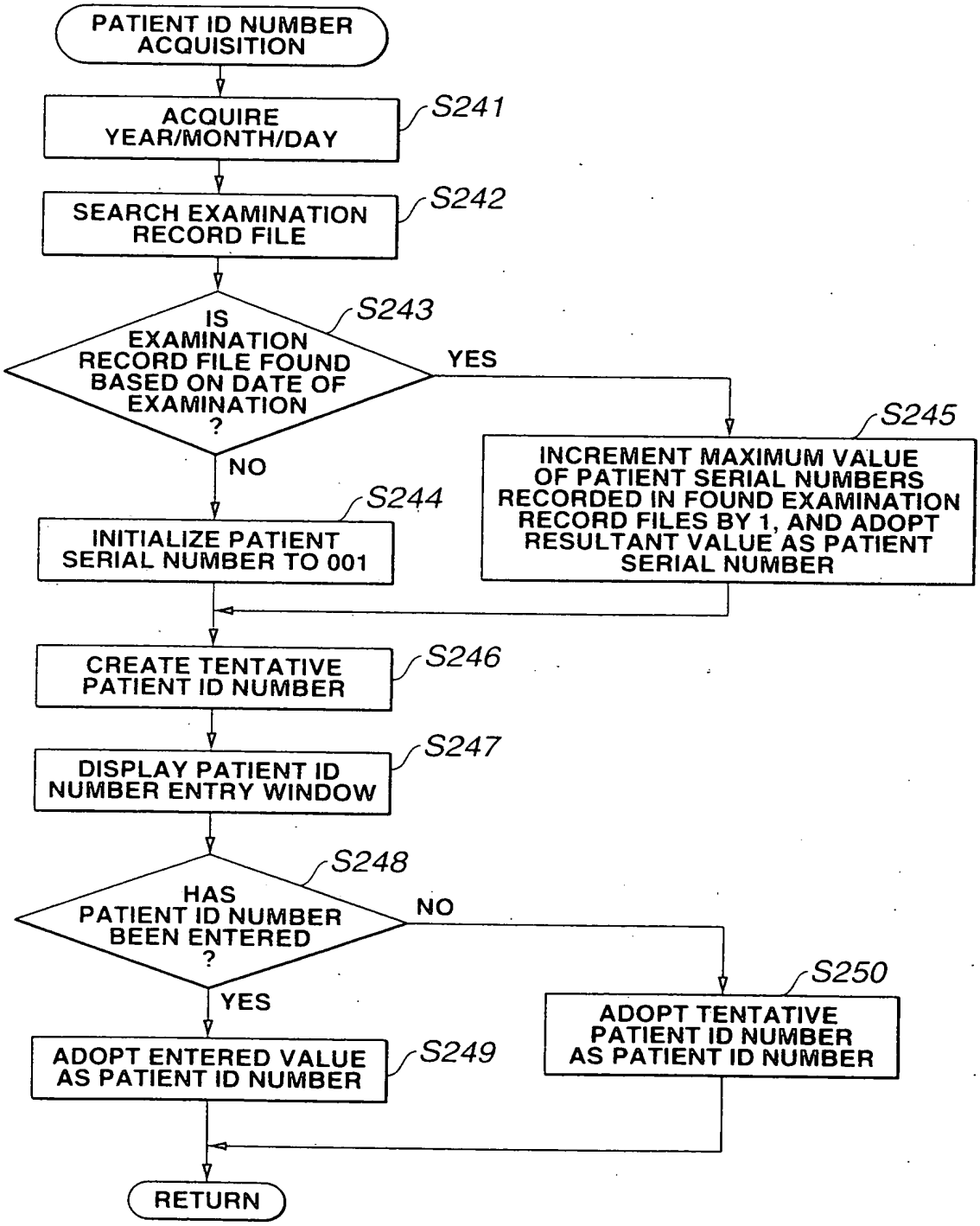

PATIENT ID NUMBER ACQUISITION
ACQUIRE YEAR/MONTH/DAY
S241
SEARCH EXAMINATION RECORD FILE
S242
IS EXAMINATION RECORD FILE FOUND BASED ON DATE OF EXAMINATION ?
S243
YES
NO
INITIALIZE PATIENT SERIAL NUMBER TO 001
S244
INCREMENT MAXIMUM VALUE OF PATIENT SERIAL NUMBERS RECORDED IN FOUND EXAMINATION RECORD FILES BY 1, AND ADOPT RESULTANT VALUE AS PATIENT SERIAL NUMBER
S245
CREATE TENTATIVE PATIENT ID NUMBER
S246
DISPLAY PATIENT ID NUMBER ENTRY WINDOW
S247
HAS PATIENT ID NUMBER BEEN ENTERED ?
S248
NO
YES
ADOPT ENTERED VALUE AS PATIENT ID NUMBER
S249
ADOPT TENTATIVE PATIENT ID NUMBER AS PATIENT ID NUMBER
S250
RETURN

FIG.54

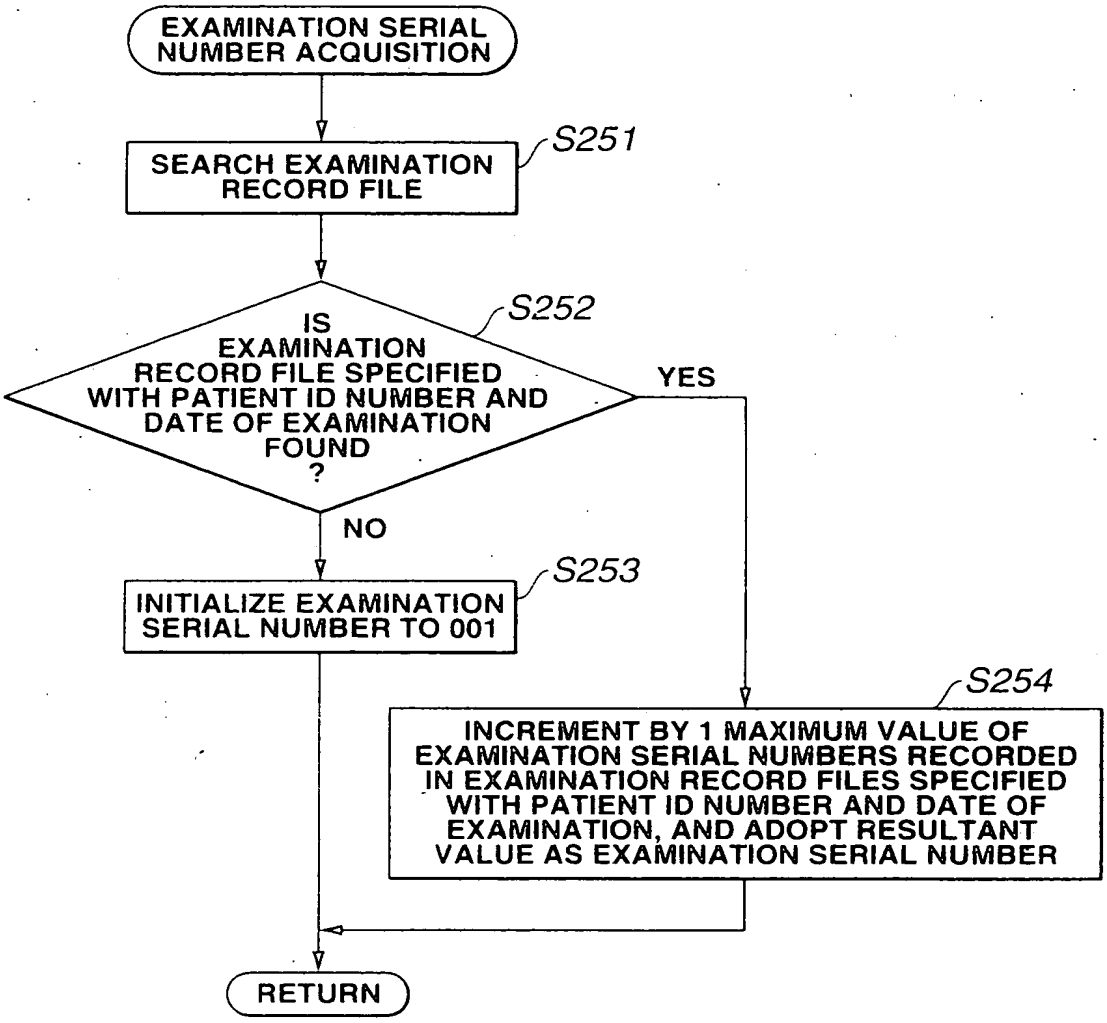

EXAMINATION SERIAL NUMBER ACQUISITION
SEARCH EXAMINATION RECORD FILE
S251
IS EXAMINATION RECORD FILE SPECIFIED WITH PATIENT ID NUMBER AND DATE OF EXAMINATION FOUND ?
S252
YES
NO
INITIALIZE EXAMINATION SERIAL NUMBER TO 001
S253
INCREMENT BY 1 MAXIMUM VALUE OF EXAMINATION SERIAL NUMBERS RECORDED IN EXAMINATION RECORD FILES SPECIFIED WITH PATIENT ID NUMBER AND DATE OF EXAMINATION, AND ADOPT RESULTANT VALUE AS EXAMINATION SERIAL NUMBER
S254
RETURN

FIG.55

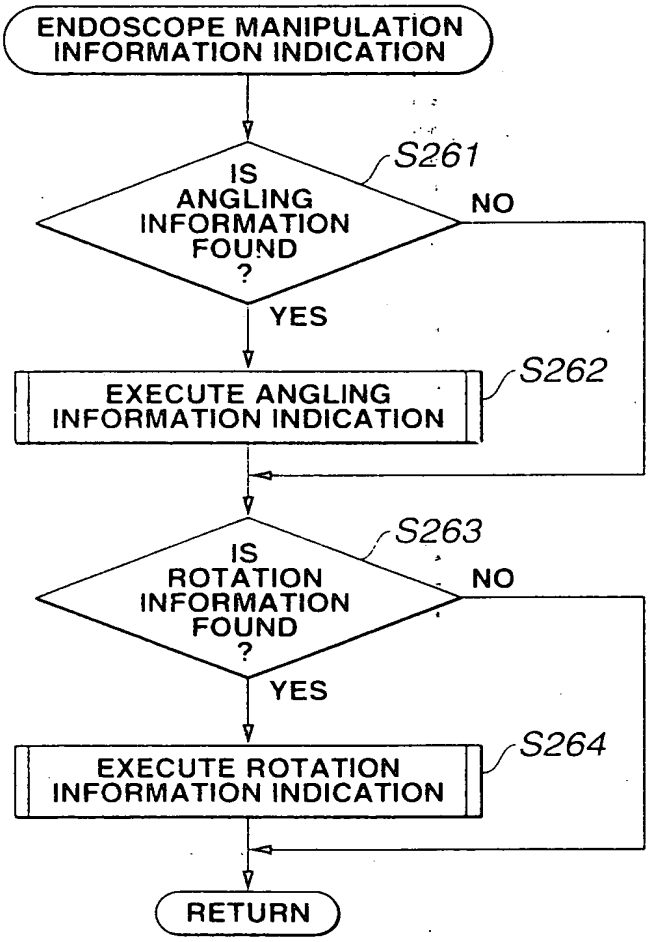

ENDOSCOPE MANIPULATION INFORMATION INDICATION
S261
IS ANGLING INFORMATION FOUND ?
NO
YES
EXECUTE ANGLING INFORMATION INDICATION
S262
S263
IS ROTATION INFORMATION FOUND ?
NO
YES
EXECUTE ROTATION INFORMATION INDICATION
S264
RETURN

FIG.56

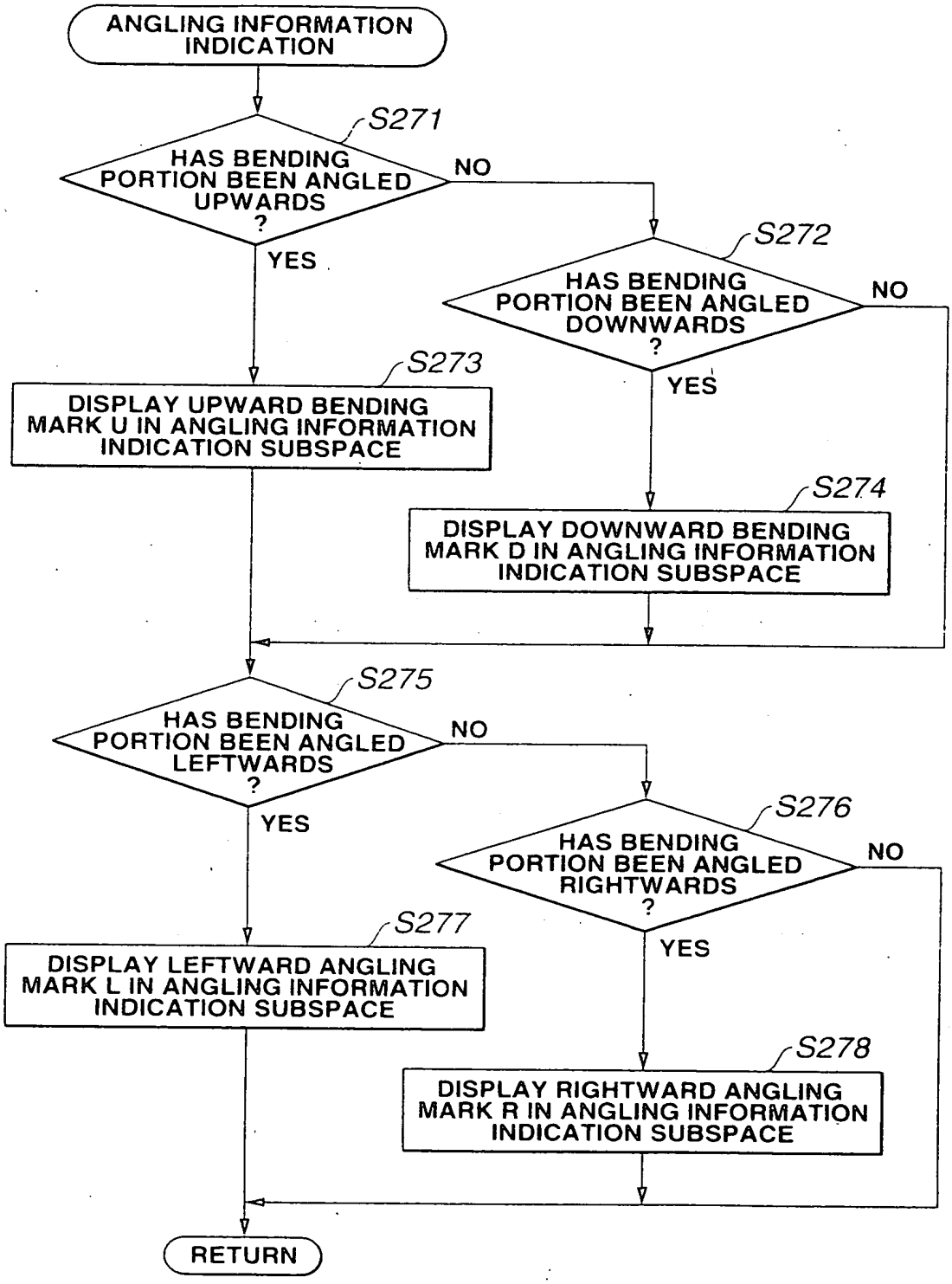

ANGLING INFORMATION INDICATION
S271
HAS BENDING PORTION BEEN ANGLED UPWARDS ?
NO
YES
S272
HAS BENDING PORTION BEEN ANGLED DOWNWARDS ?
NO
YES
S273
DISPLAY UPWARD BENDING MARK U IN ANGLING INFORMATION INDICATION SUBSPACE
S274
DISPLAY DOWNWARD BENDING MARK D IN ANGLING INFORMATION INDICATION SUBSPACE
S275
HAS BENDING PORTION BEEN ANGLED LEFTWARDS ?
NO
YES
S276
HAS BENDING PORTION BEEN ANGLED RIGHTWARDS ?
NO
YES
S277
DISPLAY LEFTWARD ANGLING MARK L IN ANGLING INFORMATION INDICATION SUBSPACE
S278
DISPLAY RIGHTWARD ANGLING MARK R IN ANGLING INFORMATION INDICATION SUBSPACE
RETURN

FIG.57

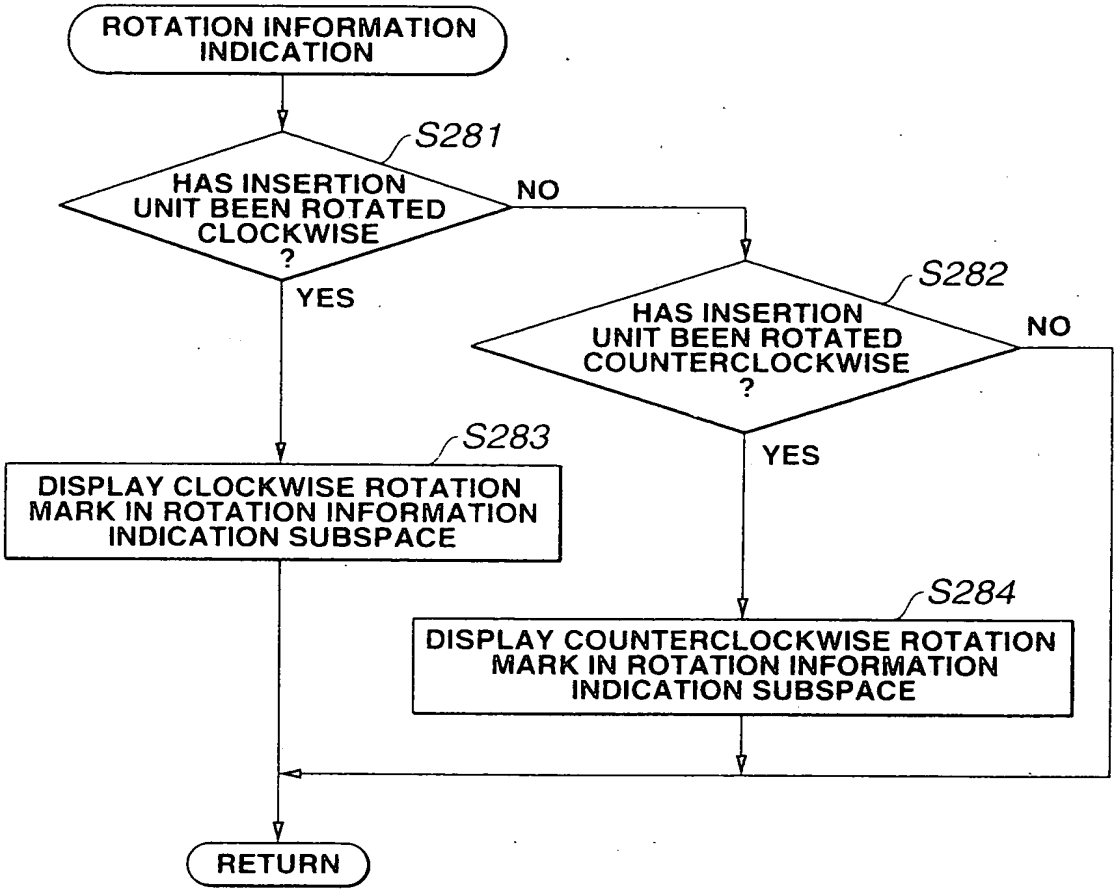

ROTATION INFORMATION INDICATION
S281
HAS INSERTION UNIT BEEN ROTATED CLOCKWISE ?
NO
YES
S282
HAS INSERTION UNIT BEEN ROTATED COUNTERCLOCKWISE ?
NO
YES
S283
DISPLAY CLOCKWISE ROTATION MARK IN ROTATION INFORMATION INDICATION SUBSPACE
S284
DISPLAY COUNTERCLOCKWISE ROTATION MARK IN ROTATION INFORMATION INDICATION SUBSPACE
RETURN

FIG.58

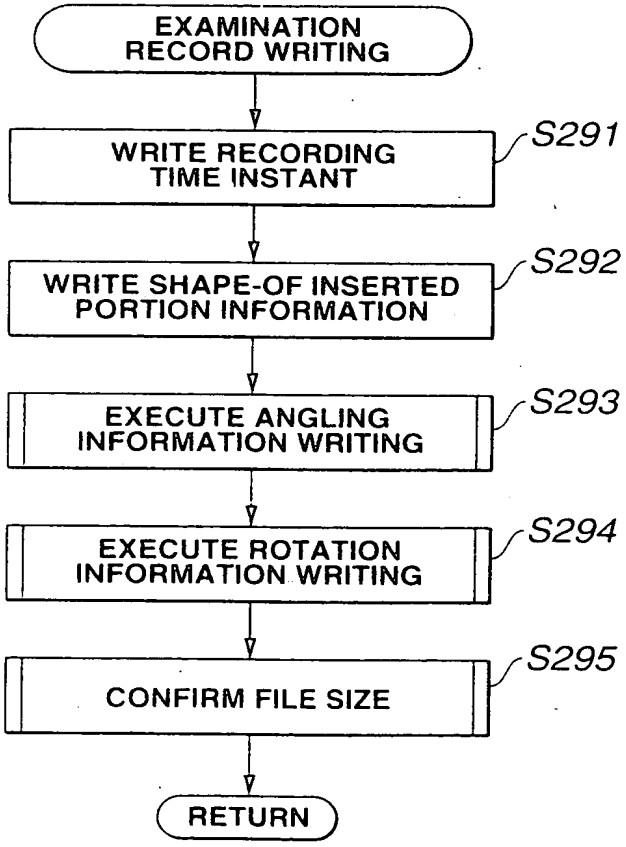

EXAMINATION RECORD WRITING
WRITE RECORDING TIME INSTANT
S291
WRITE SHAPE-OF INSERTED PORTION INFORMATION
S292
EXECUTE ANGLING INFORMATION WRITING
S293
EXECUTE ROTATION INFORMATION WRITING
S294
CONFIRM FILE SIZE
S295
RETURN

FIG.59

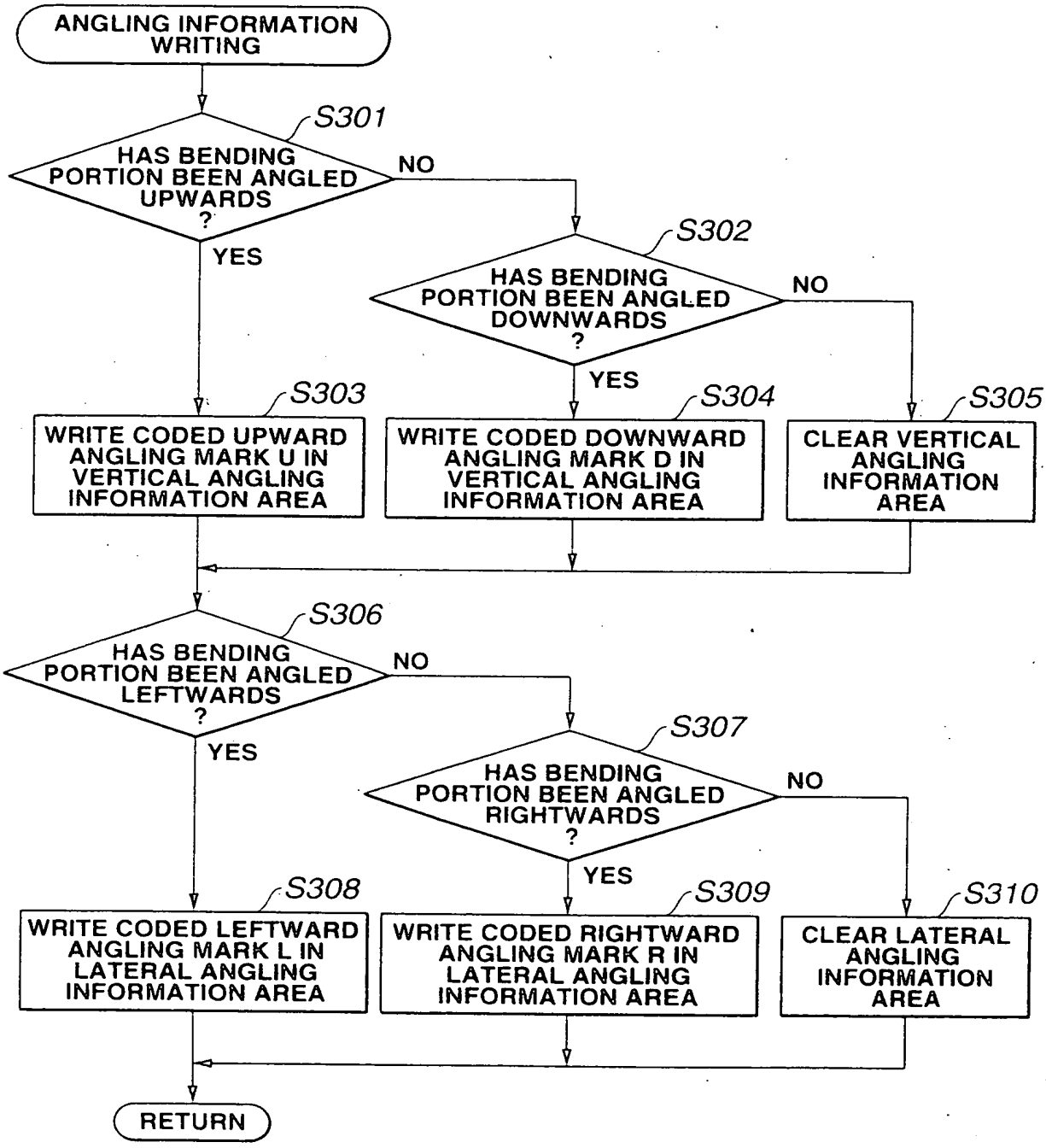

ANGLING INFORMATION WRITING
S301
HAS BENDING PORTION BEEN ANGLED UPWARDS ?
NO
YES
S302
HAS BENDING PORTION BEEN ANGLED DOWNWARDS ?
NO
YES
S303
WRITE CODED UPWARD ANGLING MARK U IN VERTICAL ANGLING INFORMATION AREA
S304
WRITE CODED DOWNWARD ANGLING MARK D IN VERTICAL ANGLING INFORMATION AREA
S305
CLEAR VERTICAL ANGLING INFORMATION AREA
S306
HAS BENDING PORTION BEEN ANGLED LEFTWARDS ?
NO
YES
S307
HAS BENDING PORTION BEEN ANGLED RIGHTWARDS ?
NO
YES
S308
WRITE CODED LEFTWARD ANGLING MARK L IN LATERAL ANGLING INFORMATION AREA
S309
WRITE CODED RIGHTWARD ANGLING MARK R IN LATERAL ANGLING INFORMATION AREA
S310
CLEAR LATERAL ANGLING INFORMATION AREA
RETURN

FIG.60

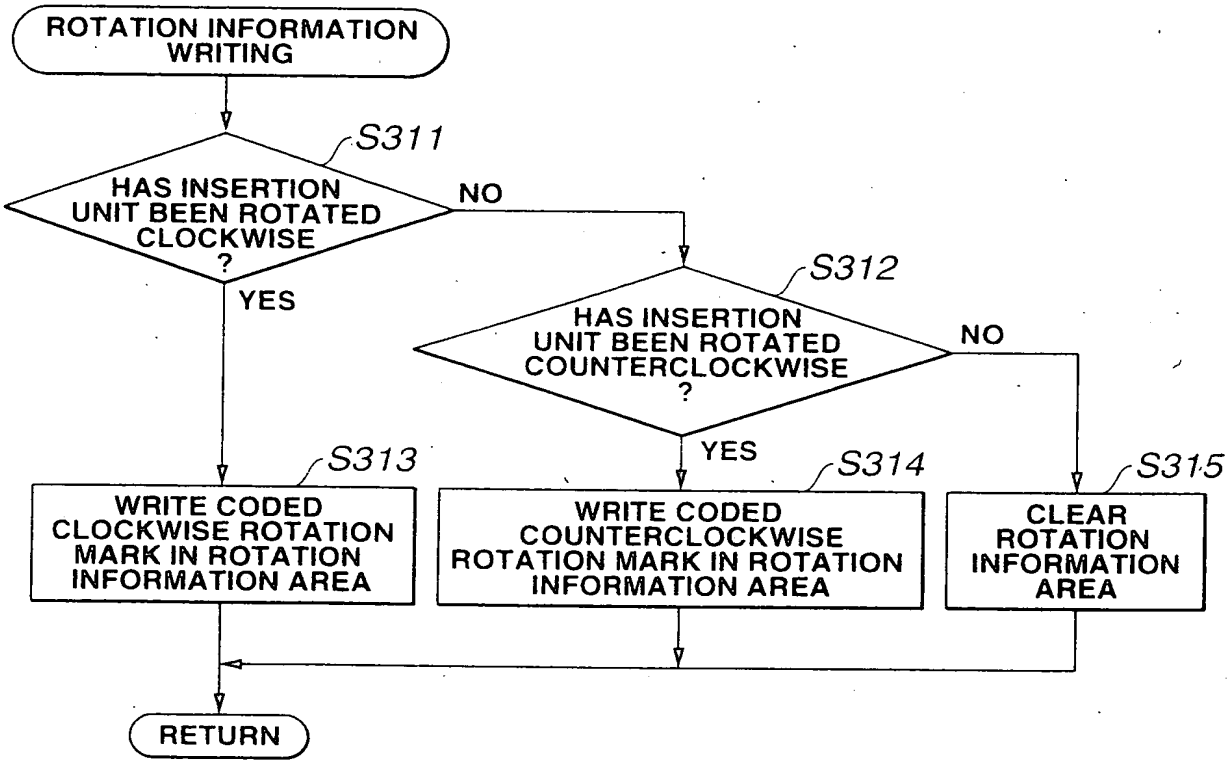

ROTATION INFORMATION WRITING
S311
HAS INSERTION UNIT BEEN ROTATED CLOCKWISE ?
NO
YES
S312
HAS INSERTION UNIT BEEN ROTATED COUNTERCLOCKWISE ?
NO
YES
S313
WRITE CODED CLOCKWISE ROTATION MARK IN ROTATION INFORMATION AREA
S314
WRITE CODED COUNTERCLOCKWISE ROTATION MARK IN ROTATION INFORMATION AREA
S315
CLEAR ROTATION INFORMATION AREA
RETURN

FIG.61

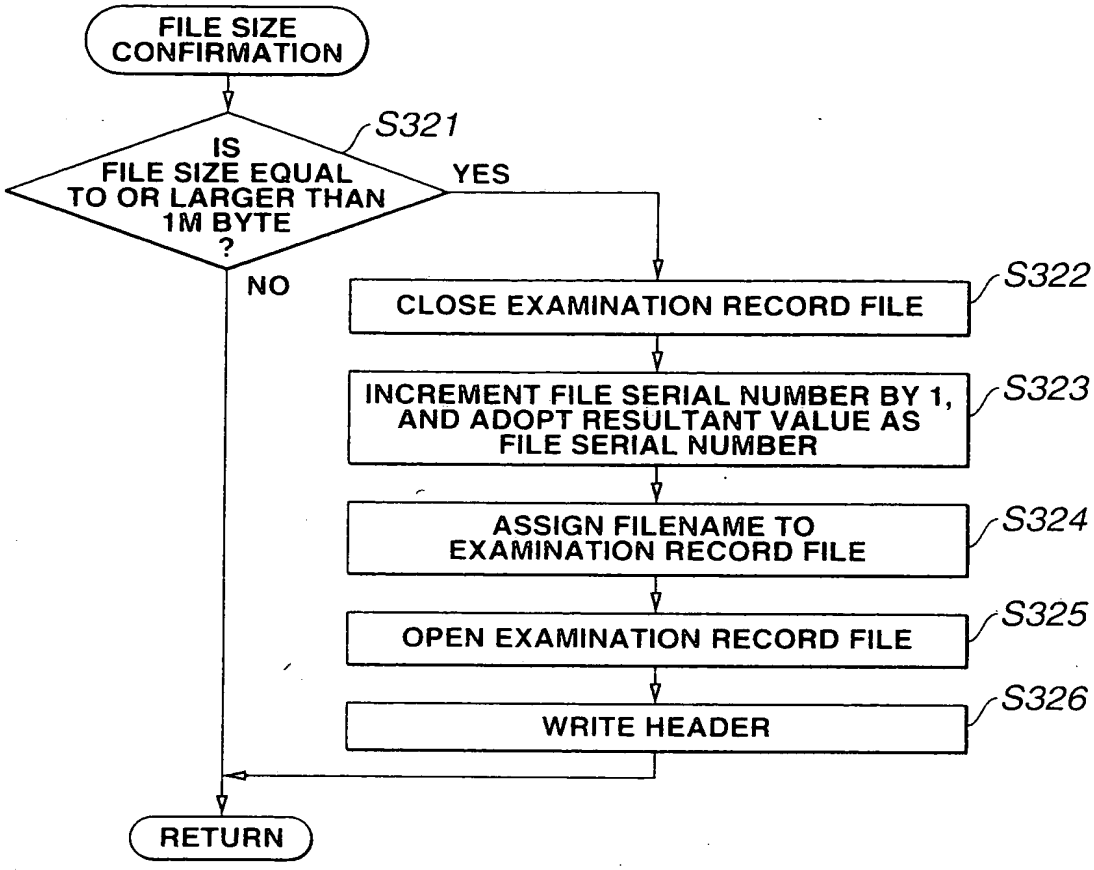

FILE SIZE CONFIRMATION
S321
IS FILE SIZE EQUAL TO OR LARGER THAN 1M BYTE ?
YES
NO
S322
CLOSE EXAMINATION RECORD FILE
S323
INCREMENT FILE SERIAL NUMBER BY 1, AND ADOPT RESULTANT VALUE AS FILE SERIAL NUMBER
S324
ASSIGN FILENAME TO EXAMINATION RECORD FILE
S325
OPEN EXAMINATION RECORD FILE
S326
WRITE HEADER
RETURN

FIG.64

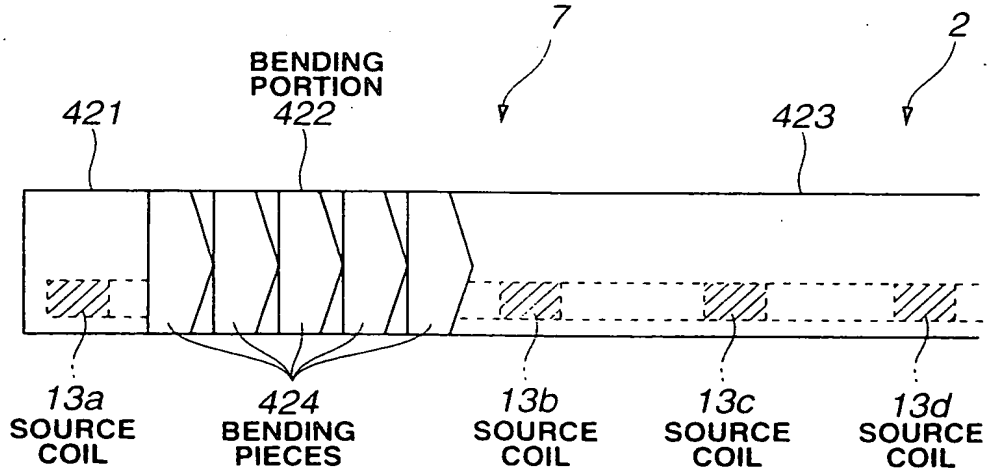

7
2
BENDING PORTION
421
422
423
13a SOURCE COIL
424 BENDING PIECES
13b SOURCE COIL
13c SOURCE COIL
13d SOURCE COIL

FIG.62

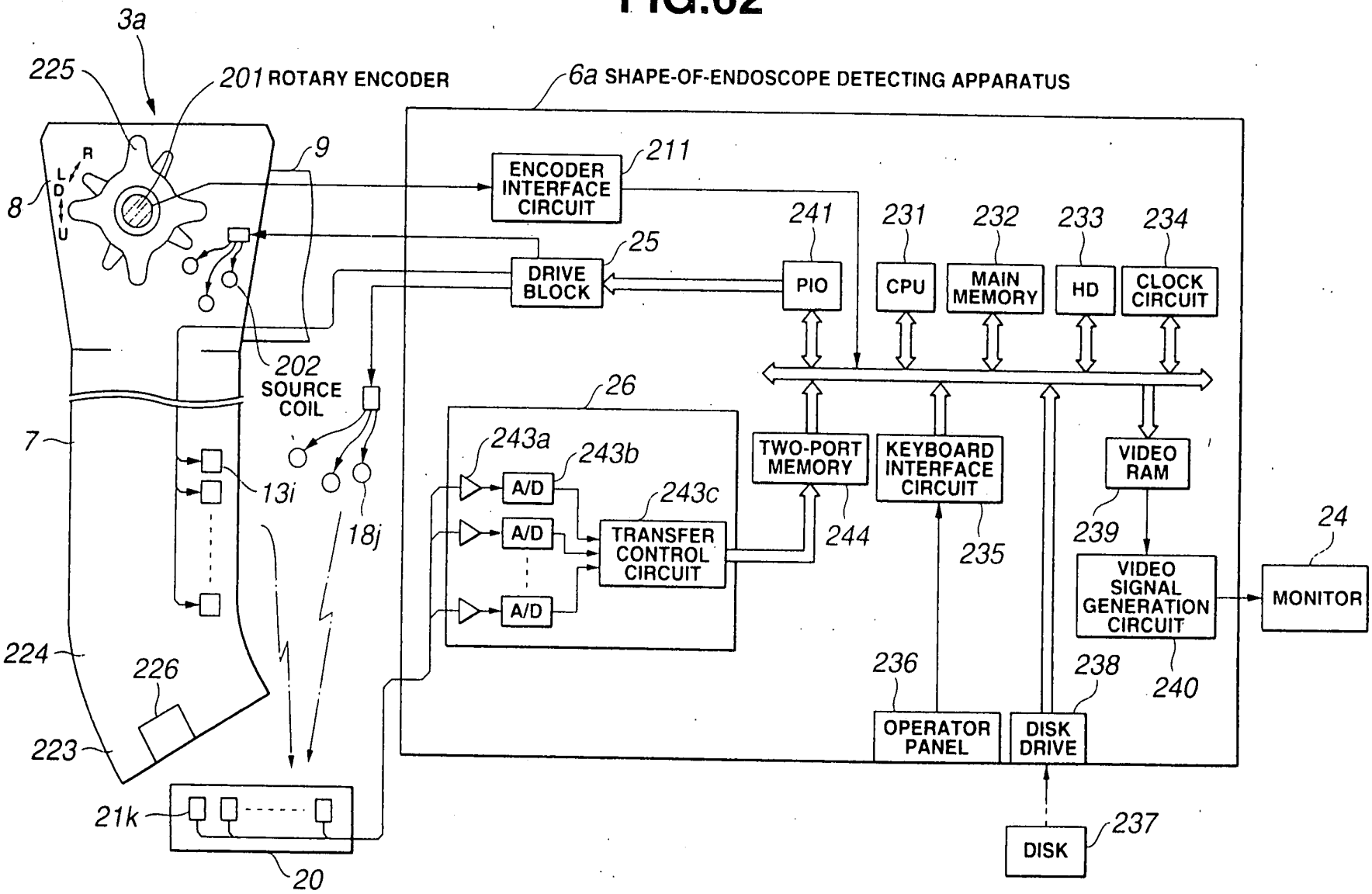

3a
225
201 ROTARY ENCODER
6a SHAPE-OF-ENDOSCOPE DETECTING APPARATUS
9
8
R
L
D
U
ENCODER INTERFACE CIRCUIT
211
241
231
232
233
234
DRIVE BLOCK
25
PIO
CPU
MAIN MEMORY
HD
CLOCK CIRCUIT
202
SOURCE COIL
26
7
243a
243b
243c
A/D
A/D
A/D
TRANSFER CONTROL CIRCUIT
TWO-PORT MEMORY
KEYBOARD INTERFACE CIRCUIT
VIDEO RAM
13i
18j
244
235
239
24
VIDEO SIGNAL GENERATION CIRCUIT
MONITOR
224
226
236
238
240
OPERATOR PANEL
DISK DRIVE
223
21k
20
DISK
237

FIG.63

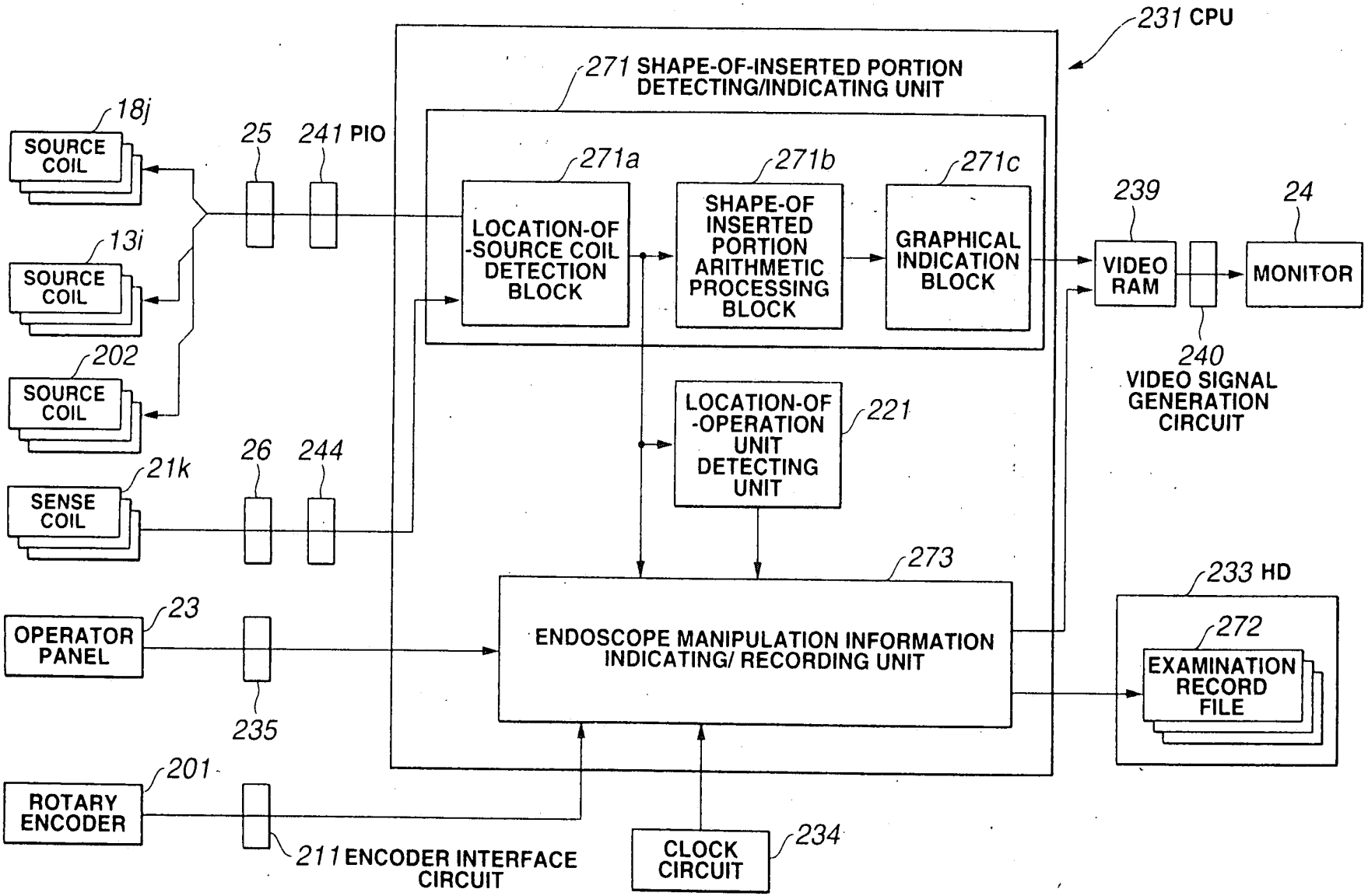

231 CPU
271 SHAPE-OF-INSERTED PORTION DETECTING/INDICATING UNIT
18j
SOURCE COIL
13i
SOURCE COIL
202
SOURCE COIL
21k
SENSE COIL
25
241 PIO
26
244
271a
LOCATION-OF -SOURCE COIL DETECTION BLOCK
271b
SHAPE-OF INSERTED PORTION ARITHMETIC PROCESSING BLOCK
271c
GRAPHICAL INDICATION BLOCK
239
VIDEO RAM
24
MONITOR
240
VIDEO SIGNAL GENERATION CIRCUIT
LOCATION-OF -OPERATION UNIT DETECTING UNIT
221
273
ENDOSCOPE MANIPULATION INFORMATION INDICATING/ RECORDING UNIT
233 HD
272
EXAMINATION RECORD FILE
23
OPERATOR PANEL
235
201
ROTARY ENCODER
211 ENCODER INTERFACE CIRCUIT
CLOCK CIRCUIT
234

FIG.65

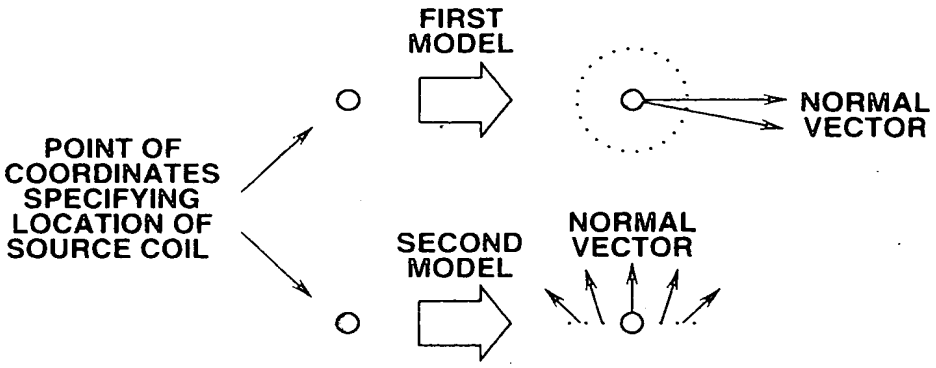

FIRST MODEL
NORMAL VECTOR
POINT OF COORDINATES SPECIFYING LOCATION OF SOURCE COIL
SECOND MODEL
NORMAL VECTOR

FIG.66

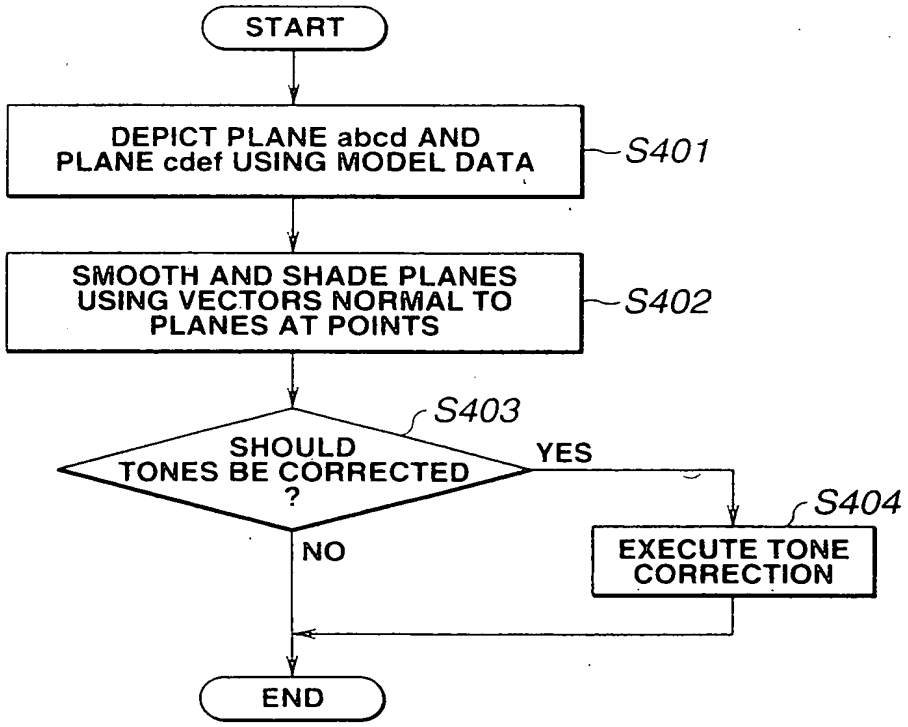

START
DEPICT PLANE abcd AND PLANE cdef USING MODEL DATA
S401
SMOOTH AND SHADE PLANES USING VECTORS NORMAL TO PLANES AT POINTS
S402
S403
SHOULD TONES BE CORRECTED ?
YES
NO
S404
EXECUTE TONE CORRECTION
END

FIG.67

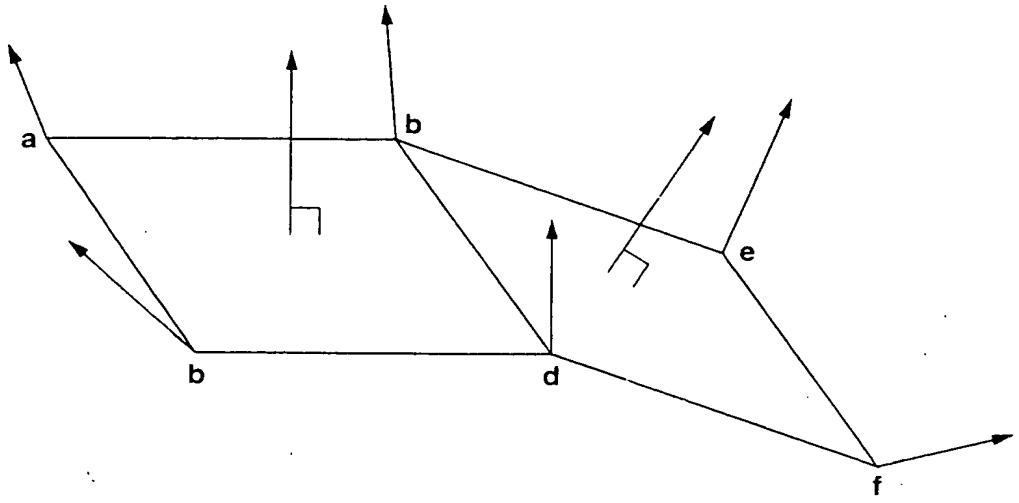


FIG.68

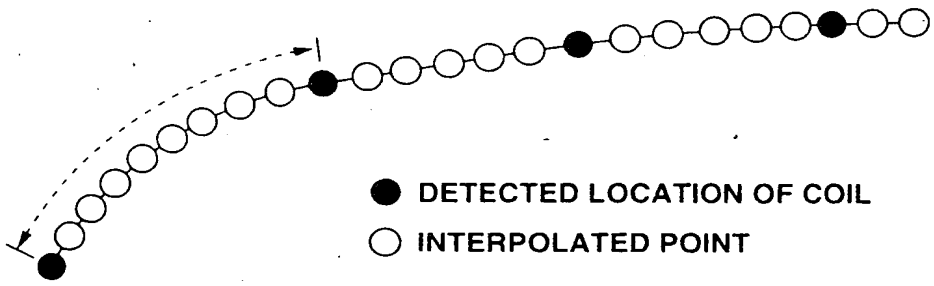


FIG.70A

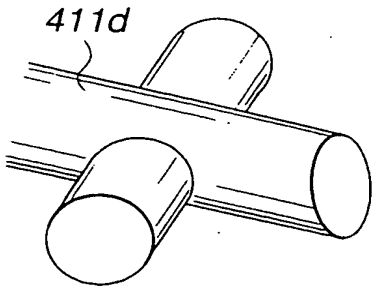


FIG.70B

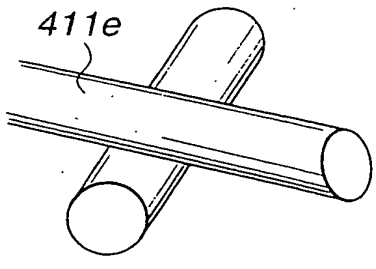


FIG.69A

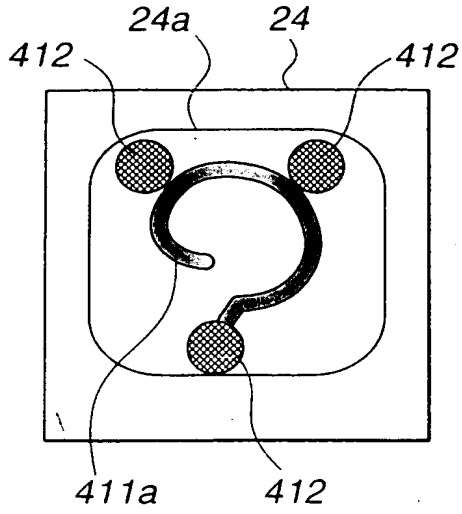


FIG.69B

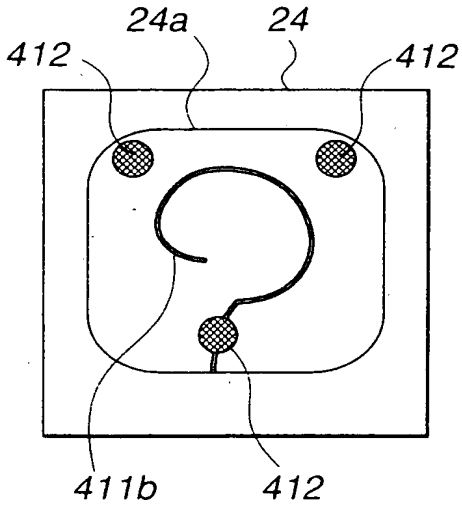


FIG.69C

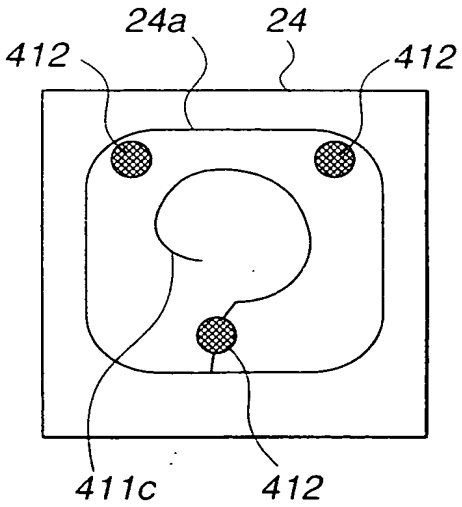


FIG.71A

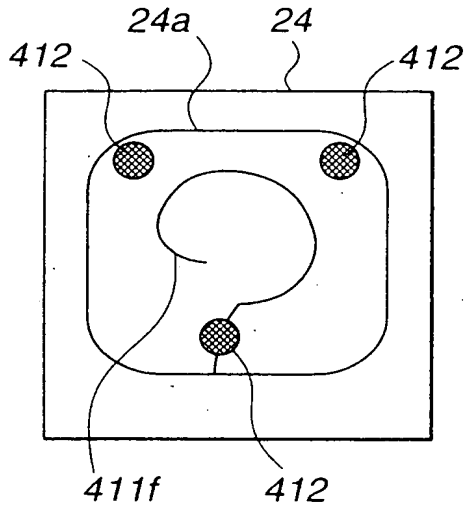


FIG.71B

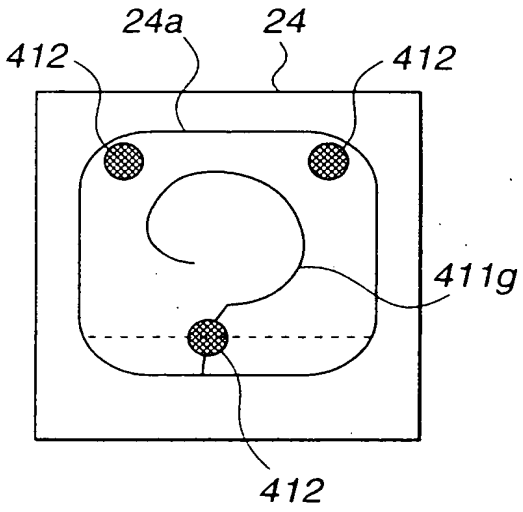


FIG.71C

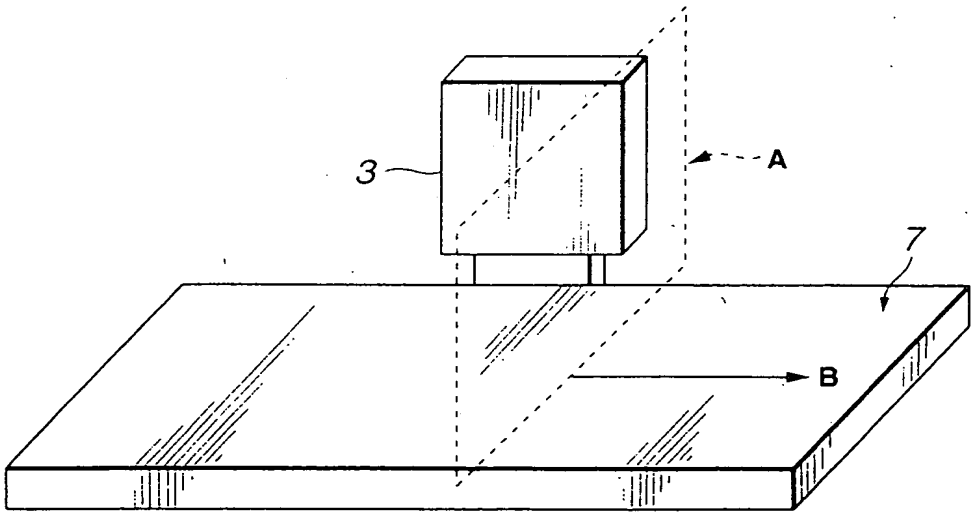


FIG.72

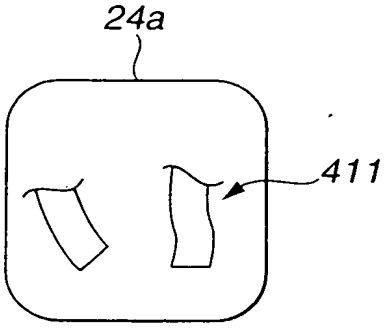


FIG.73A

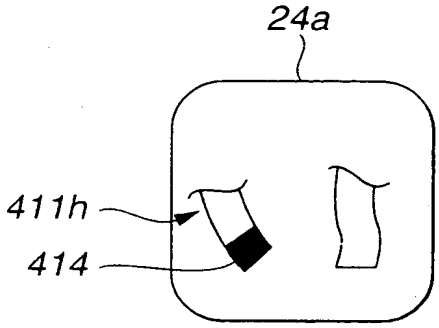


FIG.73A

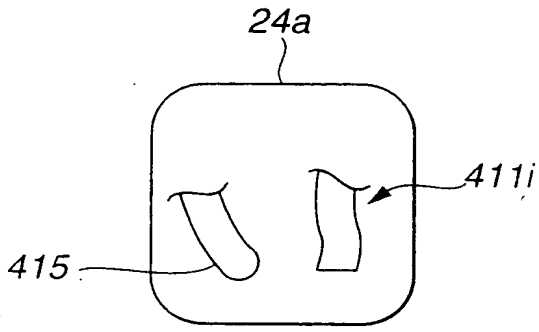


FIG.74

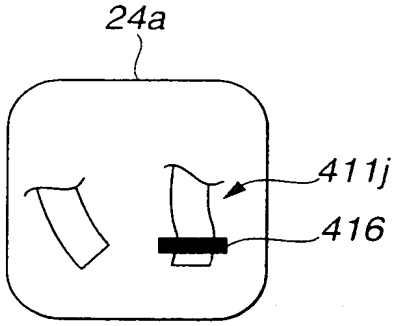


FIG.75

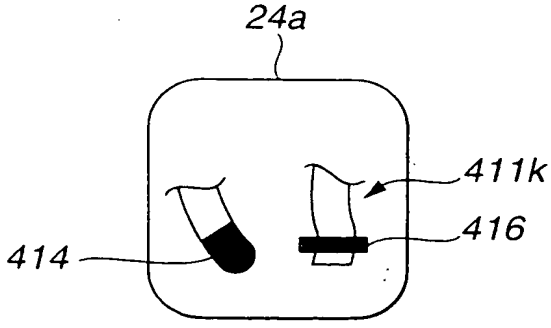
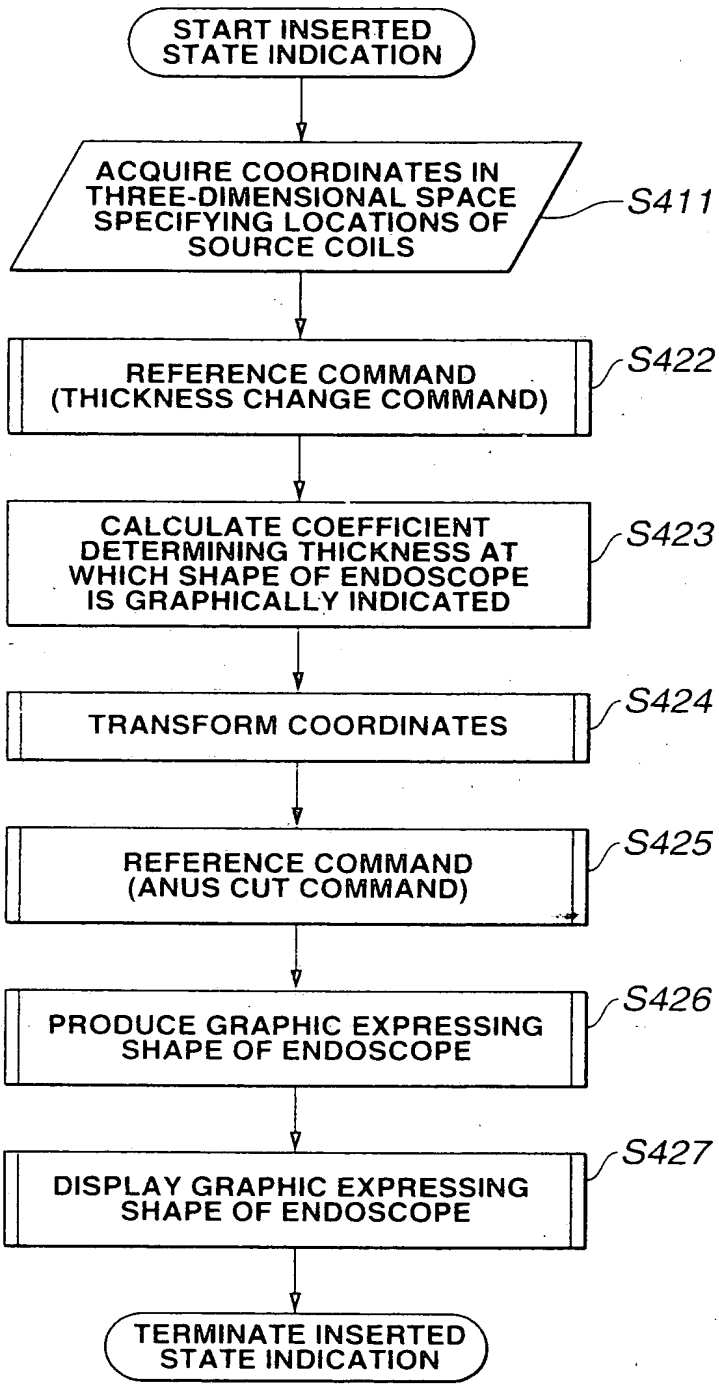


FIG.76


START INSERTED STATE INDICATION
ACQUIRE COORDINATES IN THREE-DIMENSIONAL SPACE SPECIFYING LOCATIONS OF SOURCE COILS
S411
REFERENCE COMMAND (THICKNESS CHANGE COMMAND)
S422
CALCULATE COEFFICIENT DETERMINING THICKNESS AT WHICH SHAPE OF ENDOSCOPE IS GRAPHICALLY INDICATED
S423
TRANSFORM COORDINATES
S424
REFERENCE COMMAND (ANUS CUT COMMAND)
S425
PRODUCE GRAPHIC EXPRESSING SHAPE OF ENDOSCOPE
S426
DISPLAY GRAPHIC EXPRESSING SHAPE OF ENDOSCOPE
S427
TERMINATE INSERTED STATE INDICATION